

The Cost of Own Brand Food Products as Related to their Nutritive Value

*A Thesis Presented as part fulfilment for the Award of
Master of Science in Food Business Management and Technology*

By

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For Research Carried Out Under the Guidance of

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April, 2024

Submitted to the Department of Science

Technological University of Dublin – Tallaght Campus

Declaration

I, Sinead Tobin, hereby declare that the material included in this thesis submitted for assessment for the programme of MSc Food Business Management and Technology is entirely my own work, under the guidance of my supervisor, Mary O'Connor. This work has not been submitted for any academic award at this University, or any other University or Higher Education Institute. Any use of the work of others has been fully acknowledged by reference in both text and bibliography.

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Acknowledgements

I would like to take this opportunity to sincerely thank all those who have provided me with support, guidance and assistance during the research and writing of this thesis. To all of those involved with the M.Sc. programme at Technical University Dublin and Innopharma Education, for their guidance, support and help over the course of the programme.

A special and sincere thanks to Mary O'Connor, my thesis supervisor, whose expert guidance, feedback and encouragement was invaluable in delivering this thesis.

Finally, thank you to my family, whose constant patience and support made this possible. Particularly to my parents, who have always encouraged and enabled me to pursue my academic career. To them I owe everything.

Sincere thank you to all.

Abstract

The focus of this thesis is to establish whether there is a link between the cost of own brand retail products as related to their nutritional content. The aim of this thesis is to outline any correlation between the cost of retail own brand food products and the quantifiable nutritional properties. Dietary related diseases such as cardiovascular disease and obesity have become more prevalent in Ireland in the last decade, with dietary choices being linked as the main cause of this.

Retailer own brand products were selected based on the food pyramid, with data on products obtained from public domain information published by the selected retailers. Other data was sourced from peer reviewed published research papers and other substantiated sources such as government publications and legislation. Statistical analysis was also carried out as part of this study due to the availability of raw data.

Overall, the only statistically significant difference found was between the carbohydrate values between the retail own brand products at the value and core tiers. However, there is also some evidence of the correlation between the cost of retail own brand products and the nutritional content. In addition to this, from the analysis of each individual product in terms of nutrition and the ingredient contents, the premium tier products were established more often as the most beneficial across all three product tiers.

Given the novelty of this research, it would be recommended that this analysis should be repeated on a larger product base. It is also recommended that further analysis should focus on the carbohydrate values between retail own brand products at the value and core tiers, given that this is where the statistical significance was found in this analysis.

Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
A&P	The Great Atlantic and Pacific Tea company
AI	Adequate Intake
AR	Average Requirement
CCPC	Competition and Consumer Protection Commission
DRV	Dietary Reference Values
DV	Daily Values
EAR	Estimated Average Requirement
EFSA	The European Food Safety Authority
EU	The European Union
FASI	The Food Safety Authority of Ireland
Kcal	Kilocalorie
KJ	Kilojoule
NACS	National Association of Convenience Stores
PAL	Physical Activity Level
PRI	Population Reference Intake
RI	Reference Intake
UL	Tolerable Upper Intake Level
USA	United States of America
WHO	World Health Organization

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Chapter 1

Introduction

The focus of this thesis is to assess the cost of retailer own brand products with respect to their nutritional content. This thesis will outline the cost of own brand food products across levels of the food pyramid and compare products from the top three retailers in Ireland in terms of market share, to assess if there is any variation between the cost of the products and their nutritional offering. The introduction chapter will give an overview of the history of food retail, as well as the current retail market in Ireland. The chapter will also provide an overview of the current legislation on nutritional labelling and the importance of the macronutrients and micronutrients quantified on food labels.

1.1 Review of Food Retail

The concept of buying and selling food in a ‘retail’ environment can be traced back thousands of years to ancient Rome when food was traded and sold in markets. The method of food distribution has evolved over the last century. While food distribution can vary in different geographical regions, the evolution from small corner shops into large national retailers is evident across Europe and the United States of America (USA). In the Brief History of Retail, 2018, Stanton has described this evolution using multiple eras, beginning in the early 1800’s with the corner store era. This era consisted of small stores that were convenient in location for customers that did not have to travel far, but these stores sold only a small selection of essential grocery items. Many corner shops specialised in selling one category of food, such as a butcher selling meat, a greengrocer selling fresh fruit and vegetables and dry grocers selling canned goods and other such dry grocery items. These types of shops can still often be found in smaller villages, particularly in more rural areas and are typically used as convenience stores. According to the National Association of Convenience Stores (NACS), a convenience store is a retail business that was established with the primary purpose of providing customers with a convenient location to quickly purchase from a wide array of consumable products, particularly food and sometimes fuel (NACS, 2024).

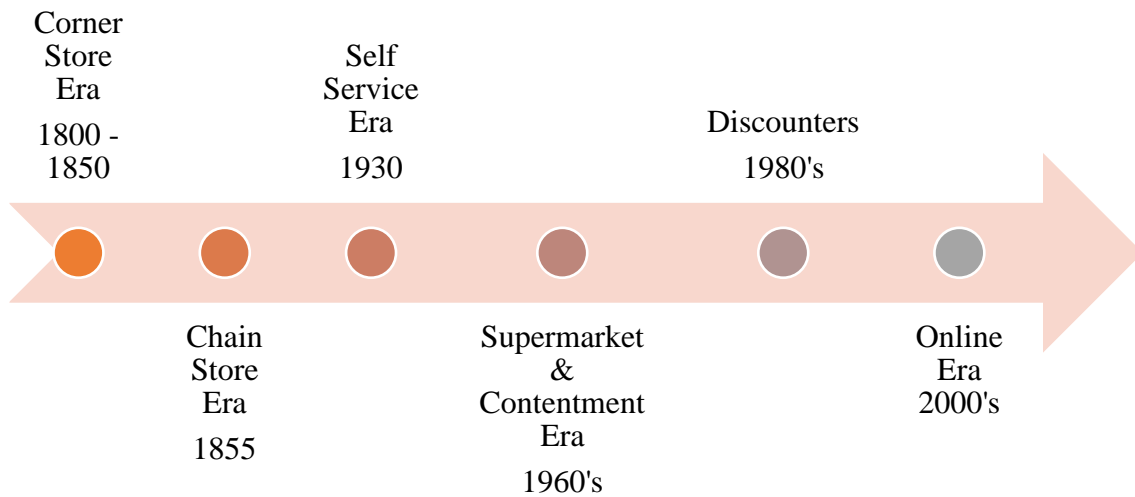


Figure 1.1 Outlining the timeline of the evolution of food retail throughout the 19th, 20th and 21st centuries, illustrating the development of food retail from corner shops in the early 1800’s to today’s format of online retail (adapted from Stanton, J.L. 2018).

The next era that Stanton describes is the chain stores initial era, beginning in the mid 1800’s. Here, stores began to be bought under one corporate brand, giving the retailer more power in terms of purchasing. This purchasing power enabled retailers to buy in bulk, and as a result, offer consumers lower prices without creating a loss of profits. This created competition, which could be linked to the cause of many small corner shops having to close down. One of the major changes in this era were logistical and operational changes. This was led in the USA by the retail chain known as the Great Atlantic & Pacific Tea Company, better known as A&P (Stanton, 2018). This retailer was the first to utilise standardisation of the store shelves, i.e. every store having the same layout. This retailer also incorporated a form of central distribution, which many large retailers currently use today. In addition to this, A&P were the first to create own brand retail products.

The third era that Stanton describes is the self-service chain store era, beginning approximately in the early 1900’s, where consumers began perusing shelves and placing items that they wished to buy in a basket and then proceeding to the counter to pay. Before this change, the consumer would ask the store operator for the desired goods that were on display behind the counter. This change in store structures encouraged impulse buying, where consumers buy items that perhaps aren’t on the shopping list or really needed, but due to the layout of the store and the display of the product, the consumer feels a sudden need to buy. This era emerged in the early stages of the twentieth century, and by 1940 it is

said that 40% of all food shopping was carried out at the self-service supermarkets. This era came slower to Britain and Ireland and was introduced on a smaller scale. It has been estimated that only ten self-service shops had been established in Britain by 1947. Despite this, self-service shops and supermarkets rapidly spread in Britain and Ireland between 1950-1960 due to the end of rationing that was introduced during the second world war (Shaw *et al.*, 2008).

In Ireland, the first supermarket opened in 1959 by Quinn John James (Clavin, 2016). Quinn worked for H. Williams and Co, one of the first grocers in Ireland, which was owned by Quinn's uncle. In 1947 he eventually took over the company and in 1959 expanded the grocer structure into a supermarket layout in which they offered multiple different types of goods, the format that we are familiar with today. Dunnes Stores was the first retailer to utilise the self-service retail model in their stores, followed quickly by H. Williams's. Ben Dunne, the owner of Dunnes Stores, opened the first Dublin branch in 1957, on Henry's Street, later followed in 1960 by an even bigger 'superstore' on South Great Georges Street, where the head office of Dunnes Stores remains today (Dunnes Stores, 2024). These stores were designed to allow the customer to browse the items on shelves, before selecting the goods and purchasing. Next came the contentment era, which resulted in little changes to the supermarket structure itself, other than size due to the changes in consumer mobility. With more affordable transport developments, consumers were now able to travel further for their shopping. This allowed retailers to become larger 'supermarkets' as customers were able to travel out of large city areas to suburban areas. Retailers started to branch out into specialised retail types such as premium retailers and discounters in order to cater to the multiple types of consumers. Discounters, such as Aldi and Lidl, first came to Ireland in 1999 as seen in the timeline of the evolution of Irish food retailers throughout the 19th, 20th and 21st centuries in Figure 1.2. These stores became increasingly popular in Ireland throughout the recession in 2009 due to the reduced-price offerings (Hennessy, 2021). This era was followed by the consolidation era.

During the consolidation era, particularly in the US, growth of the retailer became of the utmost importance. Retailers began buying out smaller chains, gaining higher market share. Globally, medium retailers became retailer giants, such as Walmart, Asda and Carrefour. Within the Irish setting, Musgraves, a food wholesale and service company, grew by acquiring other food operators. In 2004, Musgraves acquired C&R foods, and then again in 2005 they acquired Variety foods (Musgrave Marketplace, 2024). The penultimate era, the

convenience era, Stanton describes this era as the creation of prepared foods, such as ready meals and food counters. Many retailers such as SuperValu and Dunnes Stores introduced food counters such as hot food bars, sandwich bars and also salad bars, to allow for quick, convenient meals on the go. In the last decade, Dunnes Stores has refurbished many city stores to include more food counters and less grocery space, such as their Stephens Green store.

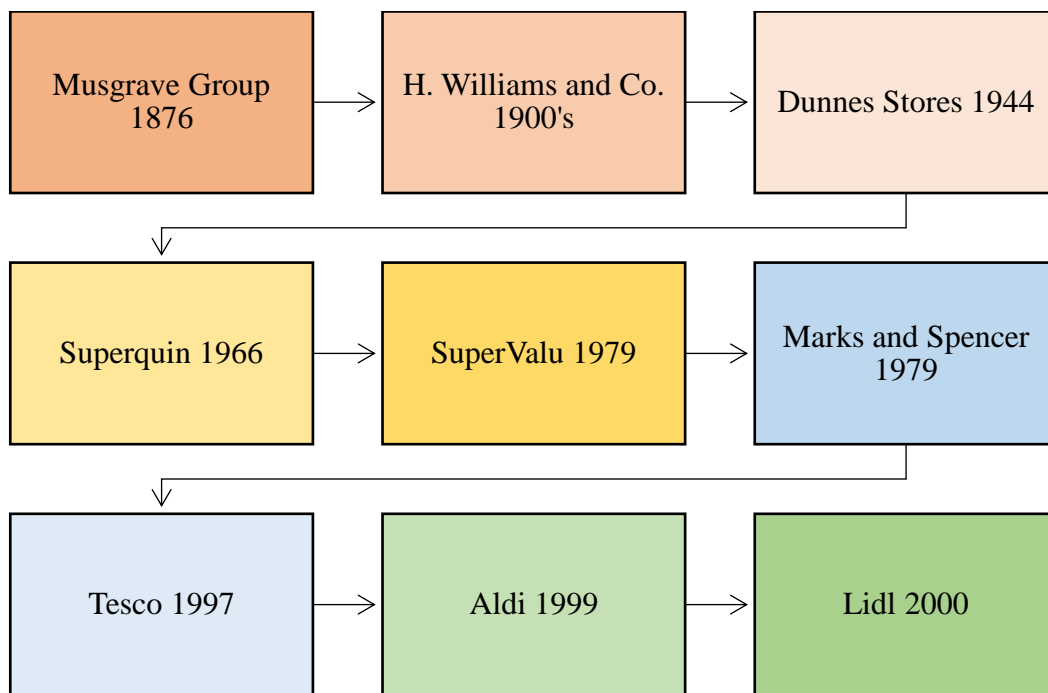


Figure 1.2 Outlining the timeline of the evolution of the Irish retail market throughout the 19th, 20th and 21st centuries. From the small corner stores to the international discounters, highlighting the approximate year in which the stores were established. (adapted from Hennessy, 2021).

The final or current era is the online era. The development of technology and distribution infrastructure has made it even easier for consumers to purchase their food without ever having to step foot inside the shop. The word ‘convenience’ is constantly changing meaning in the eyes of the consumer. In the corner store era, convenience for consumers would have been the ability to have bought all their groceries in one place. In the 2020’s, convenience in the consumers eyes, is having your shopping delivered straight to your door. Online shopping had a huge boom in interest due to the restrictions put in place to prevent the

spread of Covid-19. Now, the need has developed into a habit. Technology has played a massive role in this era, not just in home delivery, but with scan as you shop. Tesco was the first retailer in Ireland to introduced scan-as-you-shop technology (Hennessy, 2021). The NACS believe that it is pivotal for retailers to have the right technologies in place to meet the ever-increasing challenges faced, due to the expectations of the consumer developing and changing, if they want to remain competitive (NACS, 2024). Consumer demand has been an important driver of this evolution of food retailers. The demand for convenience, as well as global foods has encouraged food business operators to increase their operations in size. Throughout the various eras of food retail, it is visible how today's retailer has been shaped, and how each era brought a new innovation in order to keep up with an ever-growing consumer demand. While the history of retail has been broken down into specific eras, it should be noted that there is not a definite timeline between the end of one era and the beginning of another. While there is obvious variation in timelines between different geographical regions, multiple stages and types of retail environments exist at the same time.

1.2 The Current Market Share of Retailers in Ireland

The current retail sector in Ireland is a competitive one, with many Irish and global retailers vying for market share. The retail sector is a huge part of the Irish economy. This sector is made up of five main key retailers, as well as other minor stores and retailers. These main five retailers are Dunnes Stores, Tesco, SuperValu, Lidl and Aldi. According to statistics developed by Kantar, €3 billion was spent in grocery stores in the first quarter of 2023 alone (CCPC, 2023). Based on the grocery market share calculated by Kantar on the 19th of March 2023, the total spent in this quarter per retailer is outlined in Table 1.1.

Retailer	Market Share	Approximate Amount Spent in Store Q1 2023
Dunnes Stores	23.2%	€696,000,000
Tesco	22.1%	€663,000,000
SuperValu	20.6%	€618,000,000
Aldi	12.3%	€369,000,000
Lidl	13.3%	€399,000,000
Other Outlets	8.5%	€255,000,000

Table 1.1 The approximate amount in euros spent in each retailer in the first quarter of 2023, based on market share. (adapted from Kantar, 2024)

The market share of retailers in Ireland has fluctuated over the years. As examined in Figure 1.3, within the last decade, Dunnes Stores has claimed the top spot, currently holding 24.3%, while in 2014 they were in third place with 22.2% of the market share in Ireland. This is a gain of 2.1% in the last decade for Dunnes Stores. SuperValu saw a decline between the years 2014 to 2018, going from second place to third. They managed to reclaim some of the market share and increased this to 22.3% in 2022 during the pandemic, however, they have declined in market share again in 2024 with 20.6%, still coming third in the retailer's race. This was a total loss of 3% of the market share in the last decade for SuperValu.

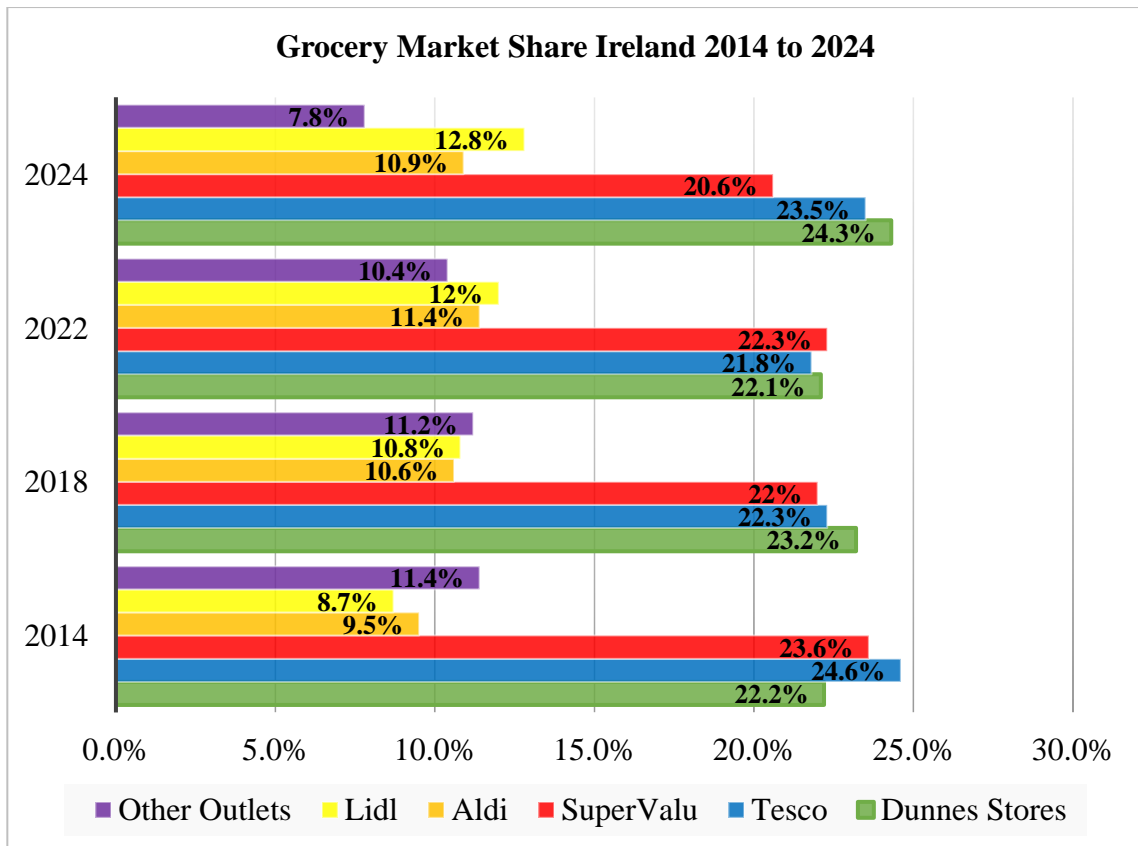


Figure 1.3 A comparison of the grocery market share in Ireland from 2014 to 2024, taken from the February of each year. (adapted from Kantar, 2024).

Tesco’s market share has fluctuated in the last decade. While in 2014 they held top place with 24.6%, in 2024 they now hold 23.5%, second to Dunnes Stores. In the last decade, Tesco had a loss of 1.1% of the total grocery market share in Ireland. The remaining three retailers accounted for in Figure 1.3 are Aldi, Lidl and an amalgamation of all the other retail outlets in Ireland such as Centra, Spar, and Daybreak. These three retailer categories have approximately half of the market share of the retailers already outlined. Despite this, one of the biggest changes in the last decade in retailer market share has been between these retailers. In 2014, Aldi held 9.5%, Lidl held 8.7% and all other retail outlets had a total of 11.4%. Comparing this to 2024, Aldi now has a market share of 10.9%, Lidl has 12.8% and the other retail outlets account for 7.8%. This is a loss of 3.6% of market share for other retail outlets, the largest loss for any retailer category in the last decade. It is also a gain of 1.4% for Aldi in the last decade, and finally a large gain of 4.1% for Lidl, the largest amount of market share gained by a retailer in Ireland, within the last decade.

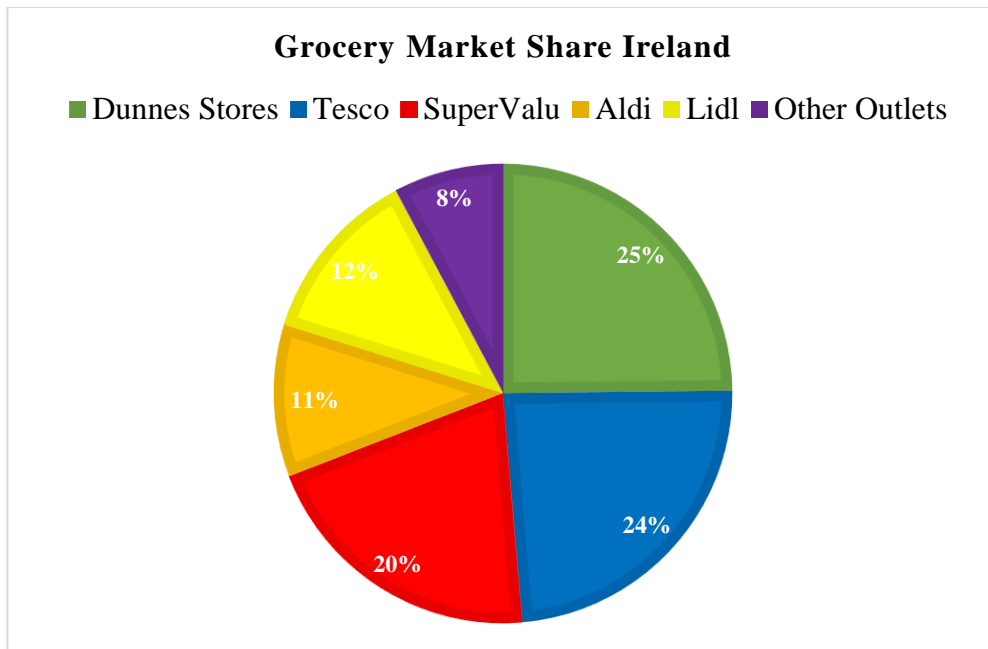


Figure 1.4 Graphical representation of the market share, rounded to the nearest whole number, of each major retailer operating in Ireland in February 2024. Dunnes Stores currently holding the top position in Ireland for several consecutive months. (taken from Kantar Statistics, 2024).

The retailers that will be used as part of this analysis will be Dunnes Stores, SuperValu and Tesco. The justification for using these retailers as part of the examination into the cost of own brand food in respect to their nutritional value, is that they have a similar market share, all in the low to mid twenty percent of the market as seen in Figure 1.4. Therefore, it could be considered that at least 60% of Irish grocery shopping is carried out in these three stores, allowing for a general population irrespective of gender, economic background and age to be considered when analysing the nutritional value of different products. Another reason that these retailers were selected to analyse is due to the tiered system that used in their own brand product offering.

1.3 Inflation and the Growth of Retail Own Brand Products

The cost of living has seen a dramatic and consistent increase in the last two decades. In 2012, Ireland's food price levels were above the EU average with the cost of meat, bread and cereal costing 10% more than the EU average (CSO, 2013). According to the Central Statistics Office, in 2016, Irish food prices were 19% above the average price of food in Europe. In 2021, in terms of food costs, Ireland had the sixth highest cost in Europe, out of

36 countries (CSO, 2022). Between August 2022 and August 2023, consumer prices rose by 6.3%, with this being the twenty third month in a row that this figure has been over 5%. Many food items have increased in price. The national average of staple foods has seen an increase, on average the price of sliced bread has increased by four cents, full fat milk has increased by eleven cents, and butter also had an increase in price of 19 cents (CSO, 2023).

Comparing the cost of food in February 2023 and February 2024, the cost of food in Ireland has increased by 4%. Food Inflation between 1976 and 2024 averaged 3.38% and current inflation is expected to be 4.2% by the end of the first quarter of 2024 (Trading Economics, 2024). Food costs in Ireland have been above average for the last two decades, and in turn with the high inflation levels in the past decade, this had led to consumers altering their spending habits, with consumers looking for ways to save money on their weekly shop and this includes purchasing more own brand products rather than branded products. Retail own brand products are those products that have been produced and packed under the name of the retailer. They are the retailers' own products, which are sold exclusively in their stores and in direct competition with previously established branded products (Sutton-Brady *et al* 2017). Some retailers such as Marks and Spencer's only sell their own private labelled products, while other retailers such as Tesco sell both branded products and their own label products. The competition between branded products and own brand products is increasing rapidly, with own brand products becoming increasingly popular. Both branded and own brand products are sold side by side on shelves, and the gap between the market share of each has been rapidly closing (Chimhundu, *et al*, 2010).

Many retailers, according to Sutton-Brady, give preferential shelf space to their own labelled products in an attempt to increase sales, resulting in more exposure for own brand products, and less for branded. The concept of own brand products can be traced back to the chain store era, with retailers such as A&P developing their own line of products for sale under their name (Stanton, 2018). The purpose of own brand labels, when first established, was to give retailers additional control over the marketing, distribution and sales of products (Bord Bia, 2019). However, own brand products have been developed and these private labels are now growing in popularity at a steady rate of about 4% a year across Europe according to Bord Bia. This growth is believed to be attributed to the retailers' capturing areas that traditional brands fall down in, and by offering consumers reduced prices for own brand products.

According to Kantar statistics, May 2023 was the first time that branded and own brand products were on equal ground in term of market share, with each holding 47.3% of the market (Healy, 2023). The current price inflation of grocery products is a definite factor behind the growth of own brand products. According to NACS, grocery inflation rose by 16.5% in May 2023. As a response to this rise in inflation, consumers alter their spending habits, including what brands they place in their shopping baskets, allowing for retailer private-branded product offerings to dramatically expand in recent years. The demand from consumers to have high-quality, low-priced offerings has led to the growth in retailers own brand offerings (NACS, 2023). With the current rate of inflation, it is no surprise that consumers are looking to reduce their shopping bill by purchasing cheaper own brand products, as opposed to higher priced branded products. According to Healy, own label products are seeing much stronger growth 16.3% (May 2023) compared to their branded counterpart whose growth was 8.2% (May 2023). This growth is believed to be a direct indication of the consumers wish to save money on their shopping bill, with the value end of the own brand product was measured at 32.3% with shoppers spending €17.5m more on these value own brand ranges.

If you look back to almost a decade ago, in 2005, on average only 9% of products purchased were own brand products. If you track this figure through the recession that occurred in Ireland from 2007 to 2009, this figure began to climb. In 2011, own brand products accounted for 35% of the market share (Leonard, 2011). In 2022, 46% of grocery sales were from own label products indicating that the frequency of consumers purchasing own brand products has been increasing steadily. This is a stark difference from when own brand labels were first established in Ireland throughout the 1980's and 1990's. Many retailers struggled to gain market share with their own brand products, with Irish consumers loyalty attributed to well-known branded products (Pope, 2022).

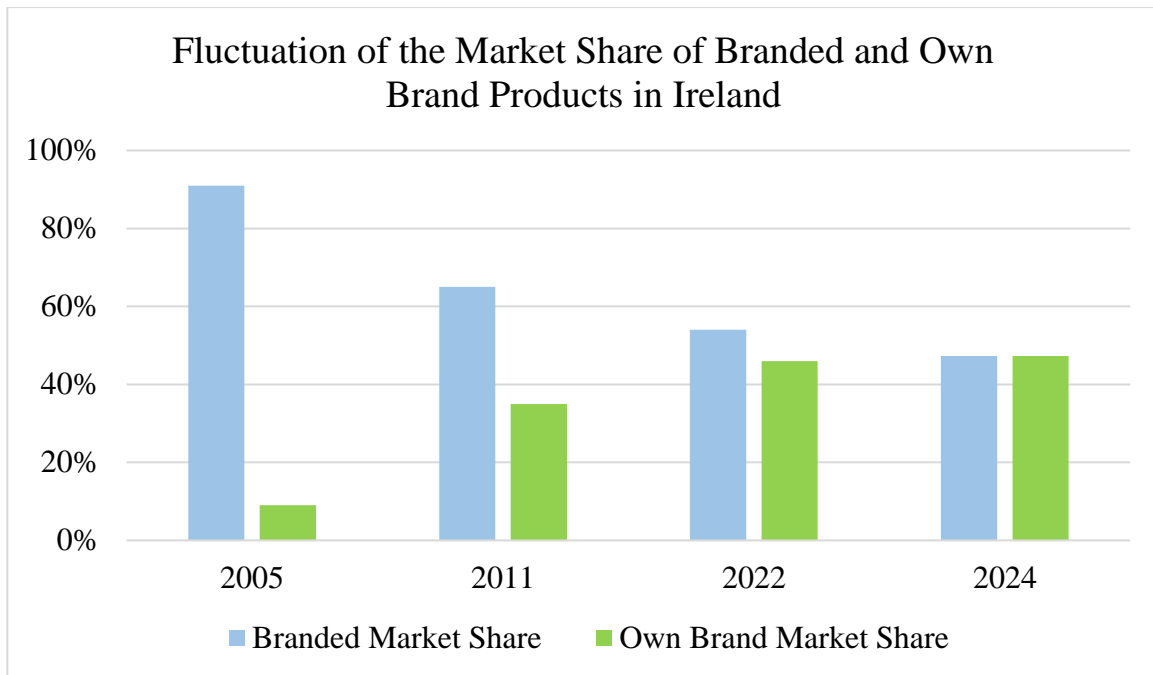


Figure 1.5 Fluctuation of market share of branded and own brand products in Ireland 2005 to 2024 (adapted from Pope, 2022).

Historically, own brand products were seen as cheap and of poorer quality than branded products, but many own brand products have been developed into premium brands and many retailers set out their own brand into a tiered system, consisting of three tiers: a value, basic tier; a core or average tier; and a premium, high-quality tier. Retailers such as Tesco, SuperValu and Dunnes Stores have introduced a tiered system into their own brand lines, in order to offer products to all types of consumers. SuperValu have a range of over 1900 own brand products for sale in their stores, across the three tiers. These tiers set out in Table 1.2. The value tier often offers customers an offering of basic products at an entry level price, while the core range provides customers with a cheaper alternative to well-known and often expensive brand. Finally, the premium range, in many Irish retailers are often Irish produced, high-quality produce (SuperValu, 2024)

Retailer	Value Tier	Core Tier	Premium Tier
SuperValu	Daily Basics Range	SuperValu Range	SuperValu Signature Tastes Range
Tesco	Everyday Value Range	Tesco Range	Tesco Finest Range
Dunnes Stores	My Family Favourites Range	Dunnes Stores Range	Simply Better Range

Table 1.2 Own brand label tiers per retailer, including the cheaper, value range, the core or average range and the more expensive premium range. (adapted from Dunnes Stores, 2024, Tesco, 2024 and SuperValu, 2024)

Despite the growth in market share for own brand products, according to data analysed by Assosia data in 2022, Tesco have been slowly reducing their own brand product offering since 2019. As seen in Table 1.3, Tesco have reduced its value-tiered products by 25% in three years (Foster-Collins, 2022). While it is unclear as to the cause in this reduction, one could hypothesize that given the amount of own label products on offer, the retail giant may have reduced their offerings in order to focus on improving the quality of the premium own label products, that are becoming increasingly more sought after. This range has only been reduced by 6.7%. While no data is available in respect of the range of other retailers aforementioned in this chapter, it does not seem to be the case based on the retailer’s own grocery websites, retailers such as Dunnes Stores and SuperValu appear to be expanding their own brand ranges. Dunnes Stores has a wide range of own brand products. Their premium tier – Simply Better is award winning and offers over 320 premium products, with 270, or 84% of these products having been produced in Ireland (Dunnes Stores, 2024). Dunnes Stores have developed their own brand range with the aim that their customers will have a choice and meet their grocery needs, no matter the budget.

Tier	August 2019	August 2020	August 2021	August 2022
Branded Products	16,355	15,577	16,465	16,119
Tesco Finest Range	890	776	821	831
Tesco Range	6,378	5,432	5,495	5,292
Everyday Value Range	422	364	339	316

Table 1.3 The gradual reduction of Tesco’s own brand range compared to the branded products available to purchase in the store. (adapted from Foster-Collins, 2022).

While retailers establish these tiers to meet a wide customer base, there is also a belief that retailers are using anchor pricing. This pricing strategy uses human nature against the customer, who will automatically go for the middle tier range, as the value tier may have the perception of poor quality due to the reduced cost. The premium tier could be viewed as too expensive, and it also has the effect of making the middle, core range look like a cheaper product, giving the consumer the perception that they will save money if they go for the middle range. In the words of Pope, consumers have an aversion to extremes and tend to pick the middle of the road when at all possible (Pope, 2022).

Changing consumer demands and expectations are challenges that retailers must face, not just in their own brand ranges but across their total product offerings. Trends in food grocery in recent years has illustrated the complexity of consumer demand. Traceability in of food, otherwise described as ‘farm to fork’ has become a big factor in consumer choice when it comes to meat and fresh fruit and vegetable products. While the farm to fork trend is one that consumers look for in addition to organic products, it is also a strategy set out by the European commission in order to ensure food security and sustainable food production throughout the EU (English, 2024). Other trends such as vegetarian or vegan diets, as well as gluten free diets have increased in popularity. While gluten free products are increasing in demand, it is unclear as to whether this is food allergies such as coeliac disease is prevalently increasing or due to the misperception that gluten free products are

healthier than products containing gluten (Boyce *et al*, 2010). This demand from consumers allows for a competitive nature between retailers. By developing their own brands in respect to current retail trends, they will more likely attain more market share. As seen in figure 1.5, the market share of own brand products has rapidly increased in the last two decades, therefore these trends must be incorporated into the products in order to maintain this demand. Other trends such as e-commerce and the expectation for a wide variety of foods from multiple origins have also presented challenges that these retailers have had to overcome, particularly during the Covid-19 pandemic, where supply chain interruptions were common, and many consumer turned to online grocery shopping to prevent contact with others (Wu, N. *et al* 2023).

1.4 Nutritional Labelling Legislation

In December 2016, due to EU legislation, it became mandatory for food business operators to display the nutritional information of prepacked food products on packaging (Food Safety Authority of Ireland, 2023). This information must be displayed on packaging per 100g of the product and it must detail what are known as the essential nutritional elements. These are the energy value in kilojoules (KJ) and kilocalories (Kcal), fat, saturated fat, carbohydrates, sugars, protein and salt content per 100g of the food product. This must be listed in the same order as illustrated in Figure 1.6 below. The nutritional information is to be displayed in a tabular format unless the pack or style of food product does not allow for space, where it is given in a list format. A food business operator can also opt to add in additional optional nutritional information for the consumer, such as traffic light colouring, nutritional information per serving and the vitamin and minerals section which do not have to be displayed unless a claim is made regarding these amounts in the product, as seen in Figure 1.6.

NUTRITION			
Typical values	per 100ml	per 200ml serving	% RI*
Energy	196kJ 46kcal	392kJ 92kcal	5%
Fat	0.8g	1.6g	2%
of which saturates	0.1g	0.2g	1%
Carbohydrate	8.1g	16g	
of which sugars	5.4g	11g	12%
Fibre	0.6g	1.2g	
Protein	1.4g	2.8g	
Salt	0.03g	0.06g	1%

NUMBER OF SERVINGS PER PACK: 5
*Reference intake of an average adult (8400kJ/2000kcal)

VITAMINS/MINERALS		
Typical values	per 100ml	per 200ml serving
Vitamin D	0.75µg (15% NRV)	1.5µg (30% NRV)
Calcium	120mg (15% NRV)	240mg (30% NRV)

NRV = Nutrient Reference Value

Figure 1.6 Illustrating the typical layout of the nutritional information of a food product as required by law, for food business to display on pack. This figure details the nutritional content of Dunnes Stores Oat milk. (taken from Open Food Facts, 2020)

Regulation (EU) No 1169/2011 of the European Parliament and of the Council details all of the mandatory information that must be displayed on food packaging. The purpose of this regulation is to ensure food operators provide clear and informative information, capable of being understood by the general consumer. This is to allow consumers to make informed choices in regard to the food that they are purchasing and consuming. Detailing the nutritional content of food per 100g of product allows consumers to compare products and make decisions in relation to their own diet, as to which they would rather purchase. The law states that “the mandatory provision of nutrition information on packaging should assist nutrition actions as part of public health policies which could involve the provision of scientific recommendations for nutrition education for the public and support informed food choices” (The European Parliament and The Council of The European Union, 2011). This regulation also prevents consumers from being misled in terms of displaying unhealthy foods as beneficial for consumers. This applies to all own brand products sold under the retailer’s own name as well as branded products prepackaged for sale.

An optional aspect of nutritional labelling is the traffic light labelling as seen in Figure 1.7 below. The traffic light label is colour coded and shows that green is low in a particular

nutrient, amber means a medium amount and red is high in a nutrient. While this is not mandatory, it has become a very popular tool for retailers to use on own brand packaging, for consumers to understand what products may be nutritionally beneficial for them and which are not. It is used to illustrate the fat, saturated fats, sugar and salt content in food. Many retailers use this style of nutritional labelling on the products in order to use it to gain market share by showing the beneficial aspects of their product in an easy and clear way for consumers to understand.

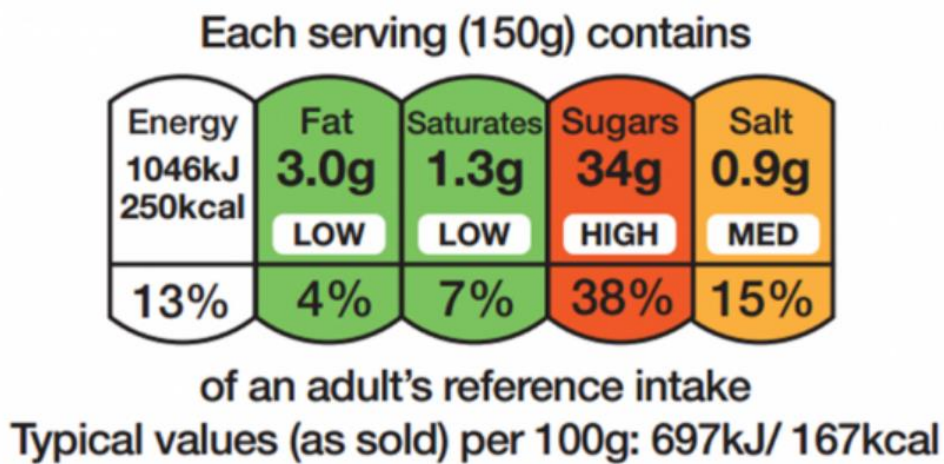


Figure 1.7 Illustrates the optional front of pack nutritional labelling that food businesses can include on food packaging, incorporating the traffic light tool. This product tells consumers that the product is low in fat and saturated fats, there is a medium amount of salt in the products, but the product is high in sugar. (taken from Food Standards Agency, 2020).

1.5 Nutrition

Nutrition is vital in ensuring the correct food is being consumed in order to have a balanced and healthy lifestyle. In today's world, much of our food is highly processed in order to account for the rapidly growing populations. In order to ensure there is enough food produced and to allow time for distribution often between continents, processed foods such as those high in energy fats and sugars are potentially being consumed equally in hand with fresh foods such as fruit and vegetables. In order to achieve a healthy diet, a balance of certain nutrients must be obtained on a regular basis. According to the World Health

Organization (WHO), a healthy diet will vary depending on the individual. The age, gender, dietary customs, level of physical activity and lifestyle must all be taken into consideration when describing what a healthy diet is for a person. However, the World Health Organization has set out basic principles as to what can be considered a healthy diet.

Firstly, it is recommended that 5 portions or 400g of fruits, vegetables, and legumes as well as nuts and whole grains such as unprocessed oats, wheat and rice must be included in the diet in order for it to be deemed a healthy diet. Secondly, the WHO recommends that no more than 10% of the total energy intake should be from free sugars. Free sugars are simple sugars that are added to food products during the manufacturing process or added to products before consumption by the consumer (Diabetes Ireland, 2024). The WHO also recommend that for a healthy diet, no more than 30% of the total energy intake should be from fats, with unsaturated fats being highly preferable to saturated fats, and trans fats being avoided as much as possible. Lastly, the WHO recommends that any salt consumed should be iodized and no more than 5 grams of salt should be consumed a day (World Health Organization, 2020). The daily calorific requirement will vary depending on the age, metabolism, and levels of physical activity of the individual. However, it is recommended that women intake approximately 2000 calories a day, while men should have an intake of 2500 calories a day, on average (NHS, 2023). While analyzing food labels for their nutritive values these recommendations on macronutrient intake, as summarized in Table 1.4, must be taken into account in order to ensure a healthy diet.

As outlined in section 1.4, the essential nutritional elements must be declared per 100g of the product on pack. The reason that these elements must be declared and are deemed essential is the requirement for a balance of all of these nutritional elements to be contained within a diet which is healthy. In order to achieve and understand this balanced diet, it is imperative that the consumer understands the amount of each essential element contained with products which are purchased and consumed. Consumer education on the role of each element is also essential, as well as the effects of over and underconsumption. These essential elements are separated into macronutrients and micronutrients. Macronutrients are the nutrients that are needed in large quantities in the diet in order for the body to function effectively. The macronutrients are carbohydrates, protein, and fat. Micronutrients, while still essential, are needed a much smaller quantities in the body. Micronutrients are minerals

and vitamins such as calcium iron and vitamin C (RWJBarnabas Health, 2019), which cannot be synthesised by the body and form essential building blocks for body function.

Macronutrients		Micronutrients
Carbohydrates	Sugars	Sodium (Salt)
	Starches	Calcium
	Fibre	Vitamin B12
Fats	Trans Fats	Vitamin C
	Saturated Fats	Magnesium
	Unsaturated Fats	Folate
Protein		Vitamin D

Table 1.4 Outlining the Macronutrients, including the sub- compounds and the Micronutrients needed in the diet to constitute a healthy diet. (adapted from Harvard, 2023)

1.5.1 Recommended Daily Amount

As outlined, a healthy diet consists of a balance of certain nutrients, that each have a particular function in the human diet, obtained on a regular basis. However, this will vary depending on the individual. The age, gender, dietary customs, level of physical activity and lifestyle must all be taken into consideration when describing what a healthy diet is for a person. The amount of each individual nutrient needed to maintain an individual’s health is called the nutrient requirement (EFSA, 2024). With regards to nutrient requirements, the European Food Safety Authority (EFSA) have set out recommended dietary reference values (DRVs) that can be further broken down into, the average requirement (AR) and the reference intake range (RI) (EFSA, 2013). These are guides set out to inform consumers as to how much of each nutrient should be consumed on a daily basis in order to qualify as a

healthy diet. This guide breaks down the values recommended per age, gender, population and activity levels.

This report focuses on the dietary needs of an average 38-year-old Irish female with average to below average physical activity levels (PAL 1.8). The decision to focus on this gender, age and physical level is justified as in 2022, 61.1% of females engaged in retail trade compared to 38.9% of males (CSO, 2023). In 2016, the most recent report available, the average age of females in Ireland was 38 years old (CSO, 2022). In 2015, just one in four women (24%) were sufficiently active to meet the national guidelines (HSE, 2016). Table 1.5 is a summary of the intake of the macronutrients recommended for an average 38-year-old female with below average physical activity levels (PAL).

Nutrient	Average Requirement	Reference Intake
Energy	2331 kcal/per	N/a
Total Carbohydrates	N/a	45-60% of the energy intake
Dietary Fibre	N/a	N/a
Total Fat	N/a	20-35% of the energy intake
Saturated Fatty Acids	N/a	N/a
Trans-fatty Acids	N/a	N/a
Protein	0.66g/Kg of body weight per day	N/a

Table 1.5 The nutrients recommended for an average 38-year-old female with below average to average physical activity levels (PAL). (Adapted from EFSA, 2024).

The recommended dietary allowance is the overall average sufficient intake of nutrients of all healthy individuals that is often used to plan adequate diets. The adequate intake is the level of intake needed to ensure an adequate amount of nutrients are present in the diet and is used when there is an insufficient information to set out the recommended dietary allowance. The estimated average requirement is the average daily level of intake estimated to meet the requirements of 50% of healthy individuals. This is typically used to assess the nutrient intake of groups of people and to plan nutritionally adequate diets for them. Lastly, the tolerable upper intake level sets out the maximum daily intake unlikely to cause adverse health effects (NIH, 2024). On many prepacked foods, the nutritional information per nutrient is often accompanied by the reference intake (RI) and the percentage daily value. Reference intake values are the amount recommended of each nutrient to consume or to not exceed consumption of each day (FDA, 2024).

As aforementioned, micronutrients are needed in much smaller quantities in the diet than macronutrients. However, they are still important in contributing to a healthy diet. The average intake of micronutrients for an average 38-year-old female with below average to average physical activity levels is outlined in Table 1.6.

Nutrient	Average Requirement
Calcium	750 mg/day
Iron	7 mg/day
Zinc	6.2 mg/day
Folate	250 µg DFE/day
Vitamin A	490 µg RE/day
Vitamin B6	1.3 mg/day
Vitamin C	80 mg/day

Table 1.6 The micronutrients recommended for an average 38-year-old female with below average to average physical activity levels (PAL). (Adapted from EFSA, 2024).

The function of calcium in the body is the aid in the formation and maintenance of healthy bones and teeth. Calcium is also needed to regulate blood clotting, muscle contraction and has also been shown to aid in the maintenance of nervous system and ensuring normal heart rhythms (Harvard, 2023). Iron is a micronutrient that is essential in the body for the production of red blood cells. Iron can be sourced through plants sources such as beans and spinach and fortified foods such as cereals and bread, but the main source is through lean meat (National Institutes of Health, 2023). A deficiency of iron is known as anaemia and can cause fatigue. Iron is absorbed by the body better when accompanied by Vitamin C. Vitamin C is also known as ascorbic acid and in addition to the absorption of Iron, is also used in the body to protect cells and to maintain healthy skin, blood vessels, cartilage and bones. Vitamin C is sourced through citrus fruits, the most commonly known source being oranges, bust also through vegetables such as broccoli, potatoes and peppers (Health Service Executive, 2023).

1.5.2 Energy value

The energy content of food is measured using calories (kcal) and kilojoules (KJ), with one kcal equalling to 4.18KJ. Energy is derived from the nutrients aforementioned in food. These nutrients are broken down , metabolised by the body and converted into energy in a form that can be utilised by human cells (Insel, 2014). Carbohydrates and protein provide 4kcal per gram and fat provides 9kcal per gram as outlined in Table 1.7. So, for every gram of the nutrient present, these are multiplied with the conversion factor and added together to receive the total energy value provided by the food product.

Nutrient	Energy Provided (Kcal)
Carbohydrate	4kcal per 1g
Protein	4kcal per 1g
Fat	9kcal per 1g

Table 1.7 The energy provided by carbohydrate, protein and fat per gram in the form of calories. This illustrates the variation of energy provided between fats and carbohydrates and protein. (adapted from National Agricultural Library, 2024).

The energy value of food is an important factor that must be considered to ensure a balanced and healthy diet. Energy is needed by the body to carry out its normal functions. However, energy balance is just as important in order to maintain body weight than incorporating the right amount of each nutrient to include in the diet. If too many calories are consumed, the body will store this excess energy as fat. If you use more energy than what was consumed, you are likely to lose weight as the body uses this stored fat reserves to continue functioning. Therefore, the amount of energy consumed should be managed in relation to your physical activity levels, age, weight and gender. According to the NHS, on average, men require approximately 2,500kcal a day and women require approximately 2,000kcal a day (NHS, 2023).

1.5.3 Carbohydrates

Carbohydrates are one of the most essential sources of energy in the human diet and are the main global source of food energy. Carbohydrates are sourced in throughout the diet in sugar, fruits, vegetables, fibres, and legumes, depending on the structure of the carbohydrate. The main subsets of carbohydrates are complex and simple carbohydrates, as well as sugar, starches and fibre. Fibre is declared as a separate group in food labelling, and so the carbohydrate content provided is declared excluding the fibre content. The fibre content is often included in nutritional declaration, while not a legal requirement. Fibre is an important aspect of the diet. Fibre is sourced from foods that are plant based and cannot be broken down fully through digestion. It is recommended that adults consume 30g of fibre in their diet per day (British Heart Foundation, 2024). There are two types of Fibre, the

first is soluble fibre, which can dissolve in water, forming a gel like substance in the gut upon digestion which aids in keeping stools soft which prevents constipation. The second type of fibre is insoluble fibre, which does not dissolve in water, aiding to establish a healthy digestive system as this fibre passes through the body without being broken down further, moving other digested food along. This speeds up the digestion process, reducing food sitting in the stomach for a long time, creating gases and effecting the gut microbiome. Lastly, fibre has also been found to have preventative quality against the forming of small blood clots that are often the cause of strokes and heart attacks.

The main difference between simple and complex carbohydrates is the rate in which they are broken down upon consumption. This is due to the structure of the carbohydrate. Simple carbohydrates are digested quickly which sends an immediate release of energy (glucose) to the bloodstream upon digestion. Simple carbohydrates are usually sugars, both natural and synthetic. Sources of simple carbohydrates include sweets, syrups, sugar and refined grains such as white flour. Complex carbohydrates on the other hand are much slower to break down, allowing for a smaller but longer lasting release of energy. Sources include legumes, fruits and unrefined (or whole grain) products such as brown rice (American Heart Association, 2023). The importance of choosing the correct source of carbohydrate in the diet is evident in Figure 1.8.

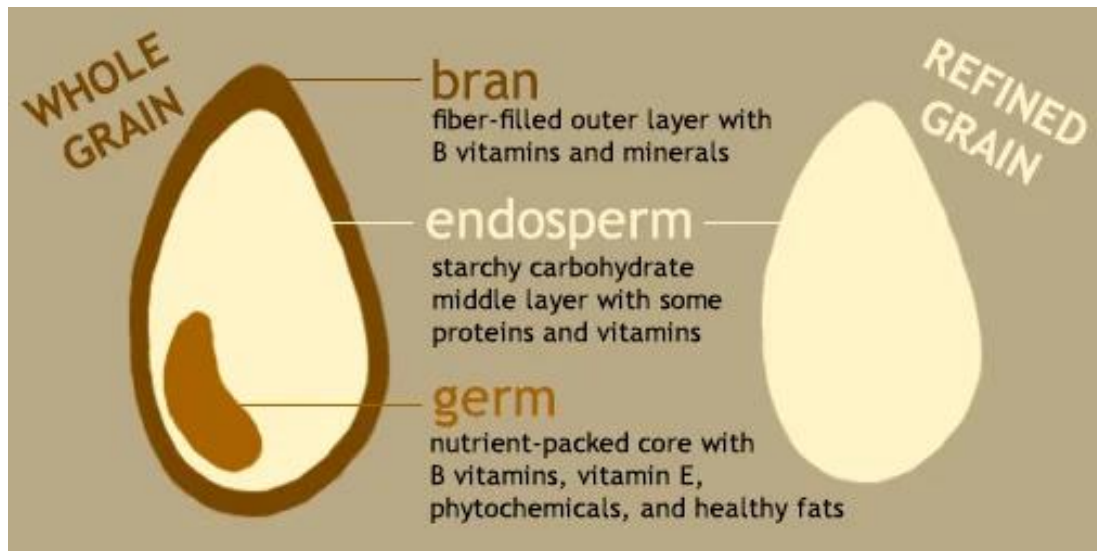


Figure 1.8. Illustrating the difference between refined and unrefined grains. Carbohydrates that are sourced from unrefined foods are much more beneficial for consumers due to the remaining presence of the bran and the germ (taken from Harvard, 2019).

Refined carbohydrates, such as white bread, rice or flour, lose many of the valuable nutrients in the refining process that are found in the bran and germ sections of the grain. The bran, which is an important source of fibre, allows for the breakdown of starches into glucose, which is essential for maintaining a steady blood sugar level rather than sharp spikes in glucose levels (Harvard 2019). The fibre from the bran will also help lower cholesterol levels, reducing the risk of heart disease.

Over consumption of carbohydrates can lead to obesity, particularly if the diet is rich in simple carbohydrates. These carbohydrates can lead to a high level of glucose in the body, which gives way to high insulin levels as a result. Insulin is a hormone released in response to glucose, with the function to move the glucose from the blood into cells where it is stored as energy. Low carbohydrate diets have come in and out of popularity since the 70's. This type of diet is very popular with those trying to reduce their weight and is often promoted by gyms. The result of this diet can often mislead people in having the misconception that carbohydrates are bad for your health and cause weight gain. As already outlined, this is not factual, and carbohydrates are an important aspect of the balanced diet. According to Bilborough and Crowe 2003, this type of low carbohydrate diet has no significant advantage over a balanced diet in terms of weight loss and maintaining a consistent weight.

While it can show immediate results in terms of weight loss due to the body using up water and glycogen stores, if this diet is maintained for a long period of time i.e. months to years, severe complications such as heart arrhythmias, osteoporosis, the increased risk of cancer and kidney damage may arise (Bilsborough & Crowe, 2003).

A diet that does not include carbohydrates can lead to low energy, which can also lead to obesity. When carbohydrates are not consumed, we feel hungry faster than if carbohydrates were consumed due to the slow energy release trait of carbohydrates. If complex carbohydrates are cut out from the diet, there is very little energy being slowly released by the body, leading to the need to increase food consumption (American Heart Association, 2023). The American Heart Association recommend that in order to achieve a balanced diet, refined foods should be limited, as well as the intake of simple sugars. Complex carbohydrates should be included in the diet daily to ensure a constant source of slowly released energy.

Carbohydrates, from a food manufacturers point of view can be a beneficial addition to food due to the low-cost value associated with carbohydrates. By reducing any one nutrient from our diet, this drives the cost of the food up as well as making it more challenging to ensure that the body gets all the nutrients needed to function (Raffensperger, 2008). If carbohydrates are removed from the diet, this will make food purchases much more expensive. Carbohydrates tend to be cheaper in cost due to the stability of the food as well as the method of growing. Many farmers plant crops such as barley and wheat as this can be cheap and easier to maintain. Therefore, using these ingredients in food manufacturing not only incorporates carbohydrates into the product but also makes the food cheaper due to the reduced value of the crop. There has also been a huge increase in the interest in premium grain for products such as oat milk drinks. Therefore, companies such as Tirlán have offered grants to farmers in an effort to produce premium grain. According to an article in Agriland, “For Harvest 2023, Tirlán will pay growers almost €3 million in additional bonuses specifically for premium grains” (Meehan, 2023).

1.5.3.1 Sugars

Sugars are a form of carbohydrate. Sugars must not be mistaken for the extracted crystallised sugar that is used in baking and to sweeten beverages such as tea and coffee. Sugars is a term that applies to all monosaccharides and disaccharides, which are the simplest forms of carbohydrates. Monosaccharides are singular sugar units and the most

common in the diet include glucose and fructose. Disaccharides are made-up of two monosaccharides and are mostly seen in the diet through sugars such as sucrose and lactose (The Sugar Association, 2024). Sugars can be both naturally occurring and synthetic. Naturally occurring sugars are found naturally in nature, such as fructose found in fruits. Sucrose is one of the most common found in the diet and is a disaccharide, meaning it is made-up of two sugars, in this case glucose and fructose, as seen in Figure 1.9.

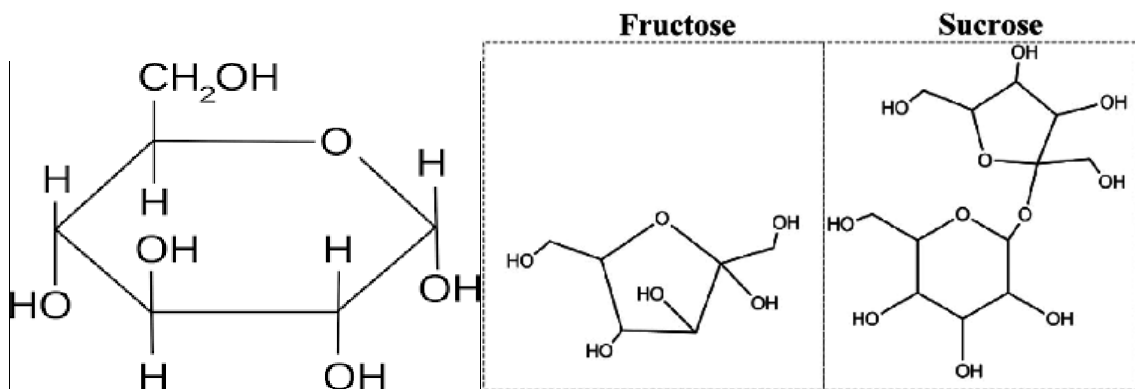


Figure 1.9 The chemical structure of glucose, a monosaccharide, taken from Manzoor, A. (2021). The chemical structure of Fructose, a monosaccharide, vs the chemical structure of sucrose, a disaccharide made up of a glucose and a fructose structure (taken from Zhu *et al*, 2016).

Sugar is a synthetic product that is made by the food industry. This sugar is made from sugar beets and sugar cane. It is added to many food products in order to enhance the flavour. The danger presented with this addition of sugar to food products is that consuming too much added sugar can lead to raised blood pressure in addition to weight gain. When sugar is added to beverages it can be particularly problematic as consuming beverages do turn off the appetite-control system of the body as liquid calories are not as satisfying as calories received from solid foods (Harvard Health, 2022). Therefore, the addition of sugar into our food products is contributing to increasing obesity levels as well as diabetes in many populations such as Ireland, the UK and all across Europe. Naturally occurring sugars are vital for a well-balanced, healthy diet. Similarly to all nutrients, if consumed in excess there will be negative effects on the body.

Added sugars, as defined by the Food and Drug Administration in 2016 as sugars that are added during the processing of foods or packaged as such, and include sugars (free, mono- and disaccharides), sugars from syrups and honey, and sugars from concentrated fruit or vegetable juices that are in excess of what would be expected from the same volume of 100% fruit or vegetable juice of the same type (Food and Drug Administration, 2016). As discussed, the World Health Organisation, has deemed that no more than 10% of the total energy intake should be from free sugars. Free sugars are another way the added sugars are described i.e. all sugars added to food or drinks by the manufacturers cook or consumer as well as including sugars that are naturally present in honey syrups fruit juices and fruit juice concentrates (World Health Organization, 2020).

High fructose corn syrup is a type of added sugar that is used to sweeten beverages and has been shown as a source of high calories particularly for children and teenagers. The problem with this syrup is the fructose metabolism as it varies from glucose metabolism. When fructose is consumed, the fructose levels in the blood will rise and peak after 15 to 30 minutes from consumption. Two hours later the fructose levels in the blood were shown to remain higher than is advised. As a result, insulin levels will be much higher in response to this. High insulin levels can lead to diabetes type 2 and have also been linked to obesity (Patterson, *et al* 2018).

1.5.4 Fat

The next macronutrient that must be displayed on food packaging in terms of the nutritive value in the food product is fats. Fats are essential in the diet, not just as a source of energy. Fats have structural roles in the body and therefore must be consumed as part of a balanced diet. Fat provides 9 calories per one gram consumed, which is more than double the energy content of protein or carbohydrates which are both 4 calories per one gram consumed. This energy is stored in the body's fat tissues and is released as fatty acids when energy is required. In addition to this, fats have an important structural function in the body. Phospholipids, triglycerides and cholesterol are fat membranes that form around cells in the body which physically separate the insides from the outside of the cells, controlling the movement of substances in and out of these cells. Another function of fat in the diet is a carrier of vitamins. Fat soluble vitamins (A, D, E & K) are carried by fats, and it supports the absorption of these vitamins in the intestine. Fatty foods containing these fat-soluble vitamins are essential in the diet (European Food Information Council, 2015).

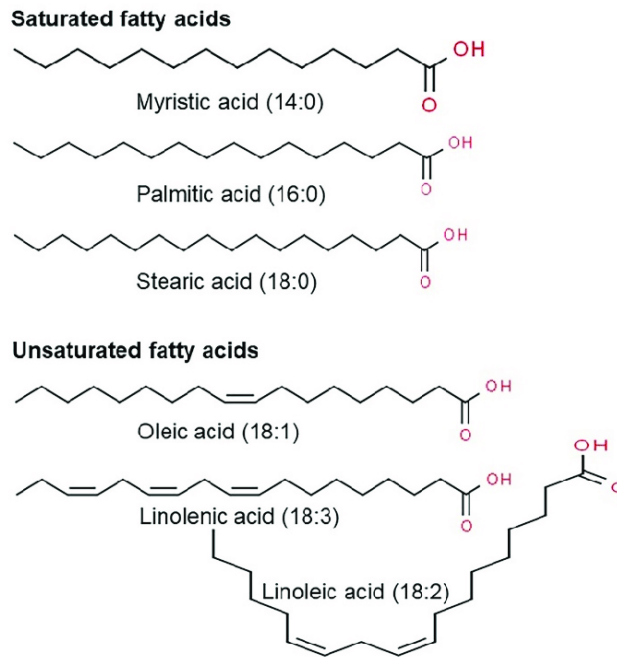


Figure 1.10 Illustrating the structural differences of saturated vs unsaturated fats. Saturated fatty acids contain no carbon-to-carbon double bonds, while unsaturated fatty acids contain at least one carbon-to-carbon double bond. This effects the stability of the fats and will affect the structure of the food at room temperature, as well as food texture and taste. (taken from Kim, I.-S. *et al.* 2021).

Fats must be declared on food packaging as fats and saturated fats. This is due to the fact that saturated fats are deemed the unhealthy fats. The main difference between these two fats is the structure as seen in Figure 1.10 above. Saturated fatty acids contain no carbon-to-carbon double bonds, while unsaturated fatty acids contain at least one carbon-to-carbon double bond (Wittman, 2022). Unsaturated fats, due to their chemical structure, are liquid at room temperature. These fats are more beneficial as they improve blood cholesterol levels compared to saturated fats which are solid at room temperature and increase risk of blood clots. Unsaturated fats are found mostly from plants sources such as vegetable oils, nuts and seeds. Avocado is a largely popular source of unsaturated fats. Fish is also an important source of unsaturated fats particularly omega-3 fats. Omega-3 fats cannot be made by the body, so it is essential that this is sourced through food as prominent levels of omega-3 fats in the blood have been associated with lower risk of premature death among older adults. In recent studies, there has also been evidenced that eating more unsaturated fats (up to 15% of daily calories) in the place of saturated fats can lower the risk of heart

disease. Saturated fats, in small amounts, can be found in most foods. However, foods such as cheese, ice cream, beef, and many other foods containing animal products or by-products are often high in saturated fats. While it is not recommended to cut out fats from the diet, but to eat good fats i.e., unsaturated fats rather than saturated fats to prevent insulin resistance which can lead to diabetes, heart disease, and high cholesterol leading to cardiac arrest (Harvard, 2018).

Trans fat, a type of saturated fat, is made by heating liquid vegetable oils in the presence of hydrogen gas and a catalyst, i.e. through the process called hydrogenation. The purpose of this is to make these fats more stable and less likely to turn rancid, it can also change the structure of the fat turning fats that are usually liquid at room temperature into solids such as turning oil into margarine. The benefit of these fats or oils for a food manufacturer is that they can be repeatedly heated without the structure being breaking down and as a result are often used in fried fast foods. Trans fats have been labelled as the most unhealthy fat due to the effect that they have on the heart and the blood vessels. As aforementioned, the WHO recommend that no more than 30% of the total energy intake daily be from fats, with saturated fats accounting for no more than 10% of this and trans fats no more than 1% (World Health Organization, 2020).

1.5.5 Protein

Protein is essential in the diet. Protein makes up muscle, bone, skin, tissues, as well as hormones and haemoglobin which is essential for circulating oxygen around the body. Proteins are made up of building blocks called amino acids. There are many different types of amino acids but there are nine that are called essential as these must be sourced through the diet as the body cannot make them. These are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine (Chan, 2023). While essential in the diet, many food related diseases have been linked to protein. The sources of protein are typically seen as red meat and poultry, and while these provide a large quantity of protein, these foods are typically high in saturated fats. Research conducted by the Harvard Chan School of Public Health has illustrated that eating large amounts of red meat often has been linked to a higher risk of cardiovascular disease, leading to higher incidences of heart disease and strokes. Therefore, plant sources of protein are important to incorporate into the diet as sources of protein, such as nuts, beans or even fish.

For food manufactures, proteins are often used in processing to alter the structure of the food. One example of this is milk proteins. The structural properties of the protein in the milk allows curd to form and transition the milk to cheese (Zayas, 2012). One of the most popular nutritional trends of the last decade is the addition of protein powder to food. Protein powder is a supplement, made from extracted protein from plants such as soybeans, eggs, or most commonly from the casein or whey protein found in milk which originally was a waste or byproduct of dairy manufacturing plants (Harvard TH Chan, 2022).

Protein supplements were originally designed for muscle building in athletes, those partaking in a vegetarian or vegan diet or for malnourished individuals, however, general consumption of these powders has rapidly increased. Based on Amazon sales in the UK, sales of protein powder have increased by 216% from 2022 to 2023 (Grylls, 2024). Whey protein powder is typically the most popular protein supplement used by today's consumer, due to its inexpensiveness and the quick absorption properties the powder possesses, making it the ideal supplement for a post workout recovery method. Despite the popularity of high protein diets using protein powders, there have been some risk factors associated with this, due to the lack of guidance in the use, as well as the different variations of protein powder available, which will lead to varying doses and effects. It has been suggested that more research should be conducted in this area, particularly in the long-term effects of using protein powders in the diet on a regular basis (Bowen et al, 2018).

1.5.6 Salt

Salt is a compound made from sodium and chloride in a ratio of 2:3. Salt is only required in very small quantities in the human body. Its main function is aiding in maintaining water and minerals, and in the conduction of nerve impulses to contract and relax muscles. Salt is used in food production as a preservative as salt draws water out of a product, and water is essential for the growth of most food pathogens. Salt is also used for flavour and as a food stabiliser. A diet high in salt can lead to hypertension (high blood pressure) which can often lead to cardiac arrest. Salt leads to an increase amount of water retained in the blood. This can put a huge strain on the kidneys and heart due to the volume of the blood being increased, creating more work for these organs (Chan, 2023). Sources of sodium in the diet are vast. Many unprocessed foods such as fruits vegetables grains meats and nuts naturally contain small traces of sodium. However, the biggest source of salt in the diet are from processed foods and not from salt freely added to food before eating i.e. for seasoning purposes. Processed foods use salt as a preservative and flavour enhancer, and is mostly

found in products such as pizza, cured meats, confectionery products such as crisps and popcorn, sauces and soups. Well not common in today's diet, a deficiency of sodium or salt in the diet leads to a condition known as hyponatremia. Symptoms of this condition include but not restricted to vomiting, headaches, confusion, lethargy and possible seizures.

According to the WHO, most populations in the world are consuming too much salt in their diets, with the average salt intake of adults currently 10.78 grams per day which is more than double what the WHO recommend (less than five grams per day). This is why salt is one of the key categories that are being highlighted in the food formulation strategy. The WHO also estimate that 1.89 million deaths occur each year that can be linked to excess sodium in the diet. It is believed that reducing sodium intake is one of the most cost-effective measures that can improve health and reduce strain on health care services, as diets high in salt lead to raised blood pressure, and an increased risk of gastric cancer, cardiovascular disease, osteoporosis, kidney disease and can also affect weight management (World Health Organization, 2023).

1.6 Food Pyramid

The food pyramid is a graphical representation of nutritional needs, illustrating the array and quantity of each foods that should be consumed in order to achieve a healthy and balanced diet, as well as to prevent or reduce the risk of developing food related diseases or disorders (Sarac et al, 2020). The food pyramid was introduced in order to make healthy eating more understandable to the general population. It is essential that different foods are incorporated into the diet as you cannot get all the required macro and micronutrients from one single type of food. In Ireland, the food pyramid is used to promote healthy eating to the population from a young age. It illustrates the importance of eating the right amount from each group in order to maintain a balanced diet. The short-term effects of following the food pyramid are that it can make a person feel good, look their best and stay at a healthy weight. The long-term effects of utilising the food pyramid in the diet is achieving a consistent healthy, balanced diet which will reduce the risk of heart disease, osteoporosis, diabetes and even some cancers (Safe Food, 2024).

The Food Pyramid

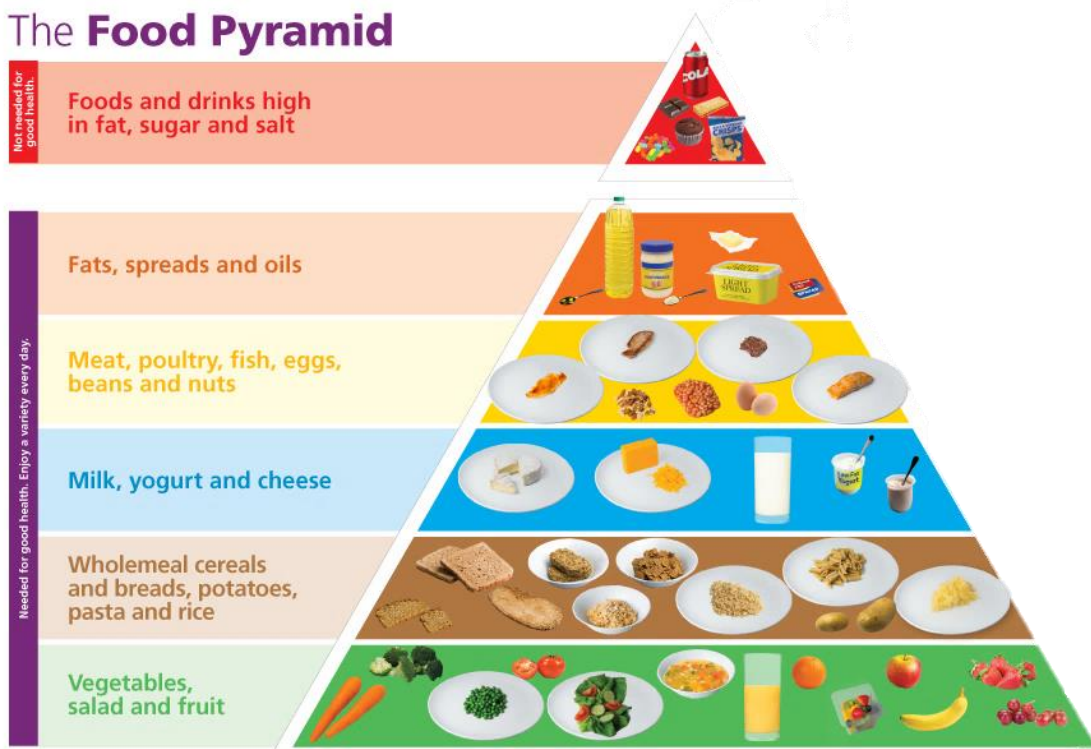


Figure 1.11 The Food Pyramid (taken from Safe Food, 2024) .

A variety of foods from each level of the pyramid should be eaten from each level in order to meet the recommended daily intake of each nutrient, but the lower down in the pyramid you are, the more of these foods should you consume. The pyramid was designed so that it allows flexibility for people to choose from an array of foods from each shelf, suiting all different types of taste (Department of Health, 2020). It is separated into five shelves, the most important shelf being the base of the pyramid. What each shelf offers are laid out as per Table 1.8. The revised version of the food pyramid separates the top shelf from the rest of the pyramid. These foods are not required to achieve a balanced diet and foods from the group should be restricted and not consumed daily. Healthy eating is all about choosing the right amounts from each shelf (Department of Health, 2020).

Shelf	Category of Food	Recommended Daily Amount
1	Vegetables, Salad and Fruit	at least 5 to 7 servings a day
2	Wholemeal Cereals and Breads, Potatoes, Pasta and Rice Wholemeal and wholegrain cereals are best	3–5 servings a day, up to 7 for teenage boys and men aged 19–50
3	Milk, Yogurt and Cheese Choose reduced-fat or low-fat varieties. Choose low fat milk and yogurt more often than cheese. Enjoy cheese in small amounts.	3 servings a day and 5 from the age of 9 to 18
4	Meat, Poultry, Fish, Eggs, Beans and Nuts. Choose lean meat, poultry (without skin) and fish. Eat oily fish up to twice a week. Choose eggs, beans and nuts. Limit processed salty meats such as sausages, bacon and ham	2 servings a day
5	Fats, Spreads and Oils (In very small amounts) Choose mono or polyunsaturated reduced fat or light spreads. Choose rapeseed, olive, canola, sunflower or corn oils. Limit mayonnaise, coleslaw and salad dressings as they also contain oil. Always cook with as little fat or oil as possible – grilling, oven-baking, steaming, boiling or stir-frying	Use as little as possible
Top Shelf	foods and drinks high in fat, sugar and salt	Very small amounts once or twice a week maximum is sufficient.

Table 1.8 The shelves as set out in the revised food pyramid, including the recommended daily amount of each category of food (adapted from Department of Health, 2020).

1.7 Ingredient Declaration and the Use of Food Additives

Ingredient declarations must be displayed on prepacked foods that contain two or more ingredients. These ingredients must be listed in order of quantity, beginning with the highest containing ingredient in the product. Each ingredient must be listed in their legal name or if a legal name is lacking, a descriptive name. This is to ensure that the consumer is not misled. Compound ingredients must also have ingredients declared on pack. Some ingredients can be listed accompanied by a quantitative ingredient declaration or quid for

short. This gives the consumer an idea as to how much of that ingredient is incorporated into the product and is displayed as a percentage of the product. Ingredients must be accompanied by a quid if they are called out on pack. For example, if a product was advertised as a strawberry ice cream, then both the strawberries and the cream in the ingredient declaration should be accompanied by a quid (Business Companion, 2024). The fourteen allergens must also be highlighted in the ingredient declaration by being in bold, in capital letters or underlined. The fourteen food allergens as set out under EU legislation are cereals containing gluten including wheat, rye, barley and oats; crustaceans, eggs, fish, peanuts, soybeans, milk, nuts including almonds, hazelnuts, walnuts, cashews, pecan nuts, brazil nuts, pistachio nuts, macadamia nut; celery, mustard, sesame seeds, sulphur dioxide and sulphites at concentrations of more than 10 mg/kg or 10 mg/l; lupin and molluscs (FSAI, 2024).

Processing aids do not have to be declared in the ingredient declaration unless they are one of the fourteen allergens. Processing aids are those ingredients used to aid the production of the product but are not consumed as a food by themselves. Any food additives incorporated into the food must also be declared in the ingredient declaration and must be declared and grouped according to function, followed by the name or its E number (FSAI, 2014). According to Article 3 of Regulation 1333/2008, 'food additive' shall mean any substance not normally consumed as a food in itself and not normally used as a characteristic ingredient of food, whether or not it has nutritive value, the intentional addition of which to food for a technological purpose in the manufacture, processing, preparation, treatment, packaging, transport or storage of such food results, or may be reasonably expected to result, in it or its by-products becoming directly or indirectly a component of such foods' (European Parliament and of the Council , 2008). Food additives are grouped according to their function or use. Table 1.9 outlines all the functional classes of food additives and the definition of each function.

Functional Class	Use in food processing
Sweeteners	Used to impart a sweet taste to foods or in table-top sweeteners
Colours	Add or restore colour in a food
Preservatives	Prolong the shelf-life of foods, preventing deterioration caused by micro-organisms
Antioxidants	Prolong the shelf-life of foods by protecting them against deterioration caused by oxidation, such as fat rancidity and colour changes
Carriers	Dissolve, dilute, disperse or otherwise physically modify a food additive without altering its function
Acids	Increase the acidity of a food
Acidity regulators	Alter or control the acidity or alkalinity of a food
Anti-caking agents	Reduce the tendency of individual particles of a foodstuff to adhere to one another
Anti-foaming agents	Prevent or reduce foaming
Bulking agents	Contribute to the volume of a food without contributing significantly to its available energy value
Emulsifiers	Make it possible to form or maintain a homogenous mixture of two or more immiscible phases such as oil and water
Emulsifying salts	Convert proteins contained in cheese into a dispersed form and thereby bring about homogenous distribution of fat and other components
Firming agents	Make or keep tissues of fruit or vegetables firm or crisp, or interact with gelling agents to produce or strengthen a gel
Flavour enhancers	Enhance the existing taste and/or odour of a food
Foaming agents	Make it possible to form a homogenous dispersion of a gaseous phase in a liquid or solid foodstuff
Gelling agents	Give a foodstuff texture through the formation of a gel

Glazing agents	When applied to the external surface of a foodstuff, impart a shiny appearance or provide a protective coating
Humectants	Prevent foodstuffs from drying out by counteracting the effect of an atmosphere having a low degree of humidity, or promote the dissolution of a powder in an aqueous medium
Modified starches	Obtained by one or more chemical treatments of edible starches, which may have undergone a physical or enzymatic treatment, and may be acid or alkali thinned or bleached
Packaging gases	Gases other than air, introduced into a container before, during or after the placing of a foodstuff in that container
Propellants	Gases other than air which expel a foodstuff from a container
Raising agents	Liberate gas and thereby increase the volume of a dough or a batter
Sequestrants	Form chemical complexes with metallic ions
Stabilisers	Maintain the physio-chemical state of a foodstuff
Thickeners	Increase the viscosity of a foodstuff
Flour treatment agents	Substances, other than emulsifiers, which are added to flour or dough to improve its baking quality
Contrast enhancers	When applied to the external surface of fruit & vegetables? impart colour

Table 1.9 The functional classes of food additives and the definition of each function. (adapted from FSAI, 2015).

Food additives are used widely in the food industry, however, there has been some negative implications linked to the use and consequential consumption of food additives in food products. According to Sambu *et al* there have been several studies that have concluded that food additives can be directly linked with health issues including, cancer, obesity, and ADHD while other food additives have been shown to interfere with hormone levels which can have an impact on growth and development and can be linked to childhood obesity (Sambu, *et al*, 2022). Food additives can be natural or synthetic. Natural food additives are those naturally found while synthetic or artificial additives are those that have been

chemically made to perform a function in food manufacturing. According to Trasande, *et al*, there has been an increase in the scientific evidence on synthetic food additives and the potential negative implications that these can have on health, particularly in children. The concern associated with the use of these synthetic additives in food has increased in the last two decades and research has shown that consumption of food with these synthetic additives is higher in low-income populations (Trasande, L, *et al*, 2018).

Organic food has become increasingly popular with consumers. Organic food must be certified by an organic body, the Irish Organic Association is the body responsible for certifying organic food in Ireland under the guidance of EU law. The logo must be displayed on pack only when the product has certified that the product has been produced using ingredients that have followed the strict guidelines. Organic food must be farmed without the use of synthetic fertilisers or pesticides, the welfare of any animals must be to the highest standard, no genetically modified organisms can be used in production of the food, the amount of fossil fuel energy used per calories of the food must be less than a non-organic product and food must be in season (Irish Organic Association, 2023).

Another important aspect of the food industry and consumer health is the fortification of food. The WHO define food fortification as the deliberate addition of certain macronutrient or micronutrients to food products in order to improve the nutritional quality of that food in order to increase public health (World Health Organization, 2024). Food fortification improves the nutritional content of foods and benefit the consumer, however, there is legislation around the fortification of food that food manufacturers must abide by. As stated in Regulation (EC) No 1925/2006, any vitamins and minerals added to foods in order to fortify them, must be in a form that is bio-available to the human body (is able to be absorbed and used in the body), and must take into account if there is a deficiency of the mineral or vitamin added, or the potential to improve the intended populations health upon consumption, and to ensure that the addition is based on acceptable scientific knowledge on the role of the vitamin or mineral in nutrition and any potential consequent effects on health (Food Safety Authority of Ireland, 2024).

1.8 Irish Health and Obesity

The standard of living and health status of one fifth of humanity is no better than it was 2,000 years ago (Watts, 2005). The imbalance of resources such as healthcare and vaccinations, food and waste management resources has led to a skewed outlook of

global disease. While 2,000 years ago, epidemic diseases such as cholera, bubonic plague, measles and smallpox were highly rampant, in today's world, particularly in developed countries such as Ireland, health issues have evolved to become more dietary/nutritional related. This shift from infectious disease to nutritionally linked diseases can be seen throughout the last century. Each era of mankind's history has a prevalent disease that seeks to claim lives. Looking back to the early 19th century technology gave way to advanced transportation, such as steamships and railways. This development of new travel modes gave way to more frequent connections around the world. This increase served as a further stimulus to the movement of pathogens, allowing for disease to spread faster and wider than it had before (Harrison, 2013). At the end of World War One, the increase in population movements gave way to the transmission of the deadly virus called influenza, causing a pandemic from 1918 to 1919 which caused at least 25 million lives. In the 1880's, AIDS (acquired immune deficiency syndrome) was a highly contagious disease that was not seen before, claiming the many lives of young adult men and women, while this disease still claims many lives each year, in Europe it is no longer the prevalent disease it once was.

The current health status in Ireland seems to be a positive one, with people living longer and healthier lives than most other European countries. The healthcare offered in Ireland is advanced, however, access to the services is often impeded by long wait times and high costs. Behavioural risk factors, rather than a virus or pathogenic bacteria, is the biggest risk of disease in the current times. Risk factors include smoking and obesity, and these elements add to the strain already on the health care service in Ireland. Since the year 2000, life expectancy in Ireland has increased by more than six years. However, over 35 % of all deaths in Ireland in 2019 could be linked to behavioural risk factors, such as smoking, poor diet, alcohol consumption and low physical activity. Dietary risks including low fruit and vegetable intake, high sugar and salt consumption, were estimated to account for about 13 % of these deaths (European Observatory on Health Systems and Policies, 2021). Therefore, Ireland has established a Sláintecare reform programme with the aim to transform how health and social care services are delivered, including an increase of funds to support the Healthy Ireland initiative that was established in 2013, which prioritises preventing the main causes of preventable deaths.

Obesity levels in Ireland have been on a rapid increase and has now become a national crisis. Between 1990 and 2001, obesity levels increased by 67% (Kiely, 2001). Obesity is

a progressive, chronic and complex disease affecting all ages and genders. Obesity is a health issue as people who are obese are more at risk of cardiovascular disease, high blood pressure and diabetes (HSE, 2024). It is important to understand the effects of obesity, and why there has been such an increase in levels across the country, and many other developed countries around the world. The Irish government have established plans in order to combat this increase in population obesity such as the reformulation strategy and the Healthy Ireland framework, which focuses on educating the public regarding health and nutrition.

According to the Healthy Ireland framework for improved health and wellbeing 2013-2025, 61% of all adults in Ireland are overweight or obese. This is an extortionate percentage of the population, with three out of every four people over the age of fifty being overweight (Department of Health, 2019). Also outlined in this survey was that lower income social classes had higher levels of obesity, with 9% of three-year-olds in lower income families being classed as obese, compared to 5% of three-year-olds in higher income families. This gives the impression that the affordability of food can have a direct impact on the nutritional quality of the food consumed. You must also contribute this to other factors such as education or genetics, but it cannot be ignored that lower income families, with less discretionary money to spend on food, are more at risk of obesity. Another study was conducted in 2020 on the obesity levels of Irish children from 1990 and 2019, and it was also concluded that the most at risk of obesity in our society are female children and those in a lower income social class. It was also determined that intervention policies, such as the reformulation guidelines are necessary to slow down these increasing statistics (O'Donnell et al, 2020).

1.9 Food Reformulation Roadmap

The reformulation strategy is an essential project, not just for consumers, but for food business operators including retailers. This strategy was set out in a roadmap due to be completed in 2025. It was outlined by Healthy Ireland and the FSAI with the aim to develop a strategy to reduce the energy, sugar, fat and salt content of food by the end of 2025. The strategy has outlined forty product categories that must be focused on by businesses to reduce the nutrients stated above. While currently a voluntary initiative, many food businesses are putting this strategy in place, encouraged to do so by the FSAI and consumer demand for healthier food. The main goal of the initiative is to reformulate existing products in the market to reduce energy and sugar values by 20% and fat and salt values by 10%. As

stated, this is not legislation in Ireland, but many food businesses have already started this process of reducing these quantities in their food products as salt reduction has become legislation in the UK. The goal of this strategy is to improve the overall nutritional intake of the population of Ireland and reduce obesity (FSAI, 2024) .

1.10 Products Selected for Comparison Analysis

A wide range of products for the comparison analysis have been selected using the food pyramid. A category of product from each level of the food pyramid has been selected and this will be analysed across the three selected supermarket own-brand ranges. The first tier of the food pyramid, as set out in Table 1.9 includes vegetables, salad and fruit, which is recommended to be consumed by at least five to seven servings a day. It was decided that for the purpose of this thesis, a product will not be analysed from this tier, as given the nature of fresh fruit and vegetables the basic nutritional value of each product will be calculated based on the same database such as Nutricalc. Therefore, it is more relevant to analyse manufactured food products.

Tier two of the food pyramid sets out wholemeal cereals and breads, pasta, potatoes and rice. The product analysed will be wholegrain bread. Based on Figure 1.12, the volume of bread sold in Ireland is much higher than sales of the other categories of product on this shelf. It is predicted that this volume is on an upward incline with an expected global volume growth of 1.1% in 2025 (Statista, 2024).

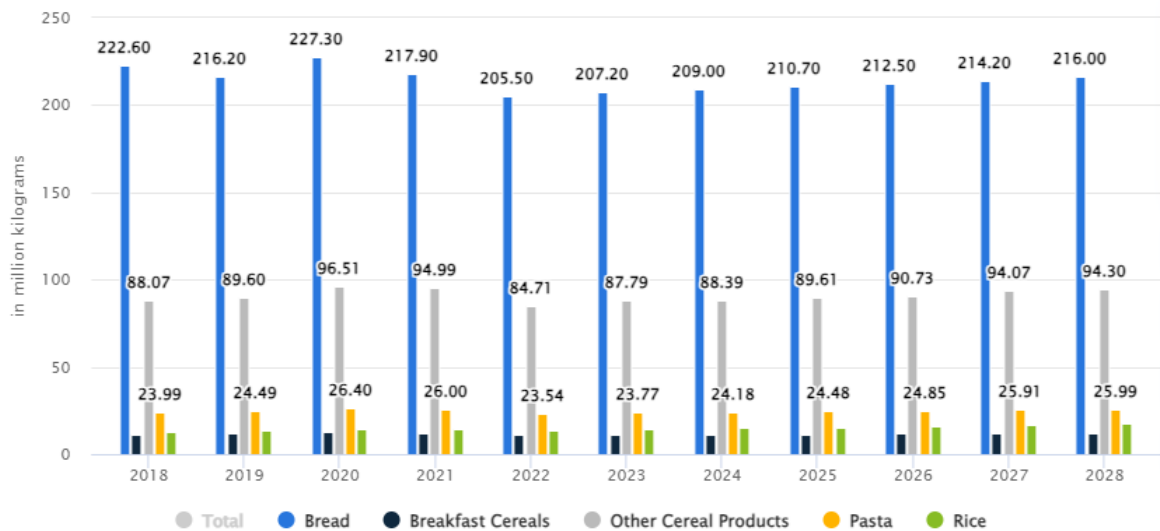


Figure 1.12 The projected volume of bread, pasta, rice and other cereals in Ireland from 2018 to 2028. (taken from Statista, 2024)

The third tier of the food pyramid includes dairy products such as milk, yogurt and cheese. The product selected for the analysis from this shelf is yogurt. The yogurt market industry in Ireland is vast. According to Bord Bia, in 2023, exports of Irish yogurt was valued at €25 million (Bord Bia , 2024). In 2021, Ireland was the second highest consumer of yogurt in Europe, second only to France. The steady increase in yogurt consumption is attributed to the association of yogurt with a healthy image as an alternative for snacking or dessert (Teagasc, 2021). Live yogurt cultures used in the production of yogurts will play an important role in the maintenance of the microbiome of the Irish population, and so this product is important to look at in comparing the ingredient declaration and the nutritional value of the product, particularly sugar levels. The microbiome is the collection of all microbes, including bacteria, fungi and viruses that are naturally found both in and on the human body (National Institute of Environmental Health Sciences, 2024). Yogurt is produced by fermenting milk using specific bacteria, or yogurt cultures, including *Lactobacillus Delbrueckii Subspecies Bulgaricus* and *Streptococcus Thermophilus*. Products with live yogurt cultures will allow for the addition of the yogurt cultures, once the yogurt is consumed, to the microbiome in the gut and aid in healthy digestion of other food.

Tier four of the food pyramid describes an array of meat, poultry, fish, eggs, beans and nuts. Again, for the purpose of this thesis, a product will not be analysed from this tier, the basic nutritional value of each product will be calculated based on the same database such as Nutricalc and is not relevant to the topic of this thesis.

The fifth tier of the food pyramid outlines fats, spreads and oils. All three retailers; Dunnes Stores, Tesco and Super Value offer only one or two tiers of these products due to the basic nature. Therefore, no product was selected from this tier.

Finally, the top shelf of the food pyramid, includes those that should not be eaten in excess. This includes chocolate, fizzy drinks and snacks such as crisps. The product that will be analysed in this tier is Chocolate Cookies. The confectionary category was valued at €601 million for the year 21st May 2022 to 2023 (Ahern, 2023). The chocolate industry in Ireland is constantly expanding, with revenue from this industry in 2022, contributing to over €200 million a year. The current consumption of chocolate per person is 3.6Kg, with Europe exporting more than 70% of the world's chocolate production (Teagasc, 2020). Cookies were chosen for this analysis as they are a typical generic confectionary product marketed towards a large sale group. By 2026, the Global cookie market is expected to reach approximately \$41.2 billion, an increase of 5.23% from 2024 (Prudent Markets, 2024).

1.11 Thesis Outline

The thesis will review the cost of retailer own brand products with respect to their nutritional content. This will be achieved through collecting and analysing the nutritive value, as well as the cost of own brand in addition to branded products. The retailers chosen for the analysis of own brand products for this analysis are Tesco, Dunnes Stores and SuperValu as these three retailers currently hold the top three spots in Ireland in terms of market share. These own brand products will then be compared to the actual cost of the product to determine if there is a link between cost and nutritional content. Focus will be on the three-tiered system used in retail own brand label product lines. This will give us an understanding of whether there is a link between low-cost food and nutritionally linked diseases such as obesity, heart disease and some cancers. The focus will be based on the macronutrients provided by each product, and the energy value contributed by each macronutrient to the calorific value of the overall product. The products were selected based on the food pyramid to determine the category of food, as well as current market trends in

Ireland in correlation with consumption. The food pyramid was utilised as order to achieve a healthy diet, a balance of certain nutrients must be obtained on a regular basis and the pyramid illustrates how to make this achievable. The analysis of food products is based on a 38-year-old female, with low to average physical activity levels, as this was the category of person most likely to be grocery shopping in Ireland.

Chapter 2

The Cost of Own Brand Food Products as related to their Nutritive Value and Associated Methods

2.1 Methods - Study Design

This chapter describes the methods used to investigate and analyse the link between the nutritional content of own brand retail products and the sale price. The research carried out was secondary, desk-based research. Data on products reviewed was obtained from public domain information published by the selected retailers and from peer reviewed published research papers and other data from substantiated sources such as government publications and legislation were utilised to conduct this research.

2.1.1 Thesis Outline of Research

The research question that this thesis outlines is whether there is a link or correlation between the nutritional value of retail own brand products and the price in which the consumer pays. Chapter one provides an overview of the history of food retail, the current retail market in Ireland, in addition to the growth of the own brand retail market. Chapter one also described the information that must be legally displayed on prepacked food items, the importance of a balanced diet and the function of the macronutrients and micronutrients that are quantified of food labels. Chapter 2 outlines the materials and methods used in order to explore the research question. Chapter 3 outlines the results and findings as a result of an analysis of selected own brand food products, across budget, core and premium tiers, as well as a branded product, based on the tiers of the food pyramid. The chapter will also provide an overview of the price that consumers pay for the product in order to assess if there is a direct link between cost and the nutritional content of processed food products. Chapter 4 will critically review and discuss the findings, allowing for supported conclusion on the research question. Chapter 5 will summarise the key findings and future work.

2.1.2 Scope

The scope of the research question is to focus on the own brand retail products of the three most successful retailers in Ireland based on market share. These retailers were selected based on their market share but also for their tiered system of pricing that the own brand products are structured according to. This includes a budget range, a core range and a premium range. Products are selected based on the tiers of the food pyramid as this concept was designed to ensure a balanced diet is achieved by the population. The focus of the research question is to analyse the nutritional content of products per 100g of products in terms of reference intake percentage in respect to their cost. It is investigated if there is a

positive or negative correlation across the three-tiered products as a full in addition to in comparison with similar branded products. The ingredients, including additives are also analysed in order to investigate the benefits of each product respectively.

2.1.3 Data Inclusions

Data included in the study was sourced from public domain information published by the selected retailers on their company websites. This data was selected in order to represent the key tiers of the food pyramid. The timeframe that data was accumulated from was from the period 2001 to 2024. Older Data used, has only been used where the data is still current and relevant and where no new data had been generated. This timeline was necessary as it was important to assess the trends in the retail environment and the changes in Ireland's economy in order to establish the potential demand for retail own brand products. It was also necessary in order to map the change in the population's health and the progression of dietary related diseases.

2.1.4 Exclusions

Non peer reviewed data has been excluded for review data. Unsubstantiated data has also been excluded from the review.

2.1.5 Statistics

27 products were analysed across own brand products and branded tiers. Statistical analysis has been carried out as part of this study due to the availability of raw data. The null hypothesis of this analysis is that there is no correlation between the cost of retailer's own brand food products and the nutritional quantity provided by each tier. The alternative hypothesis is that there is a correlation between the cost of retailer's own brand food products and the nutritional quantity provided by each tier. The significance or alpha value (α) used in this analysis is $p < 0.05$ significance level. If the p-value is less than the significance level than the null hypothesis must be rejected.

2.2 Materials

2.2.1 Population

The region selected for analysis was Ireland. Ireland has a competitive retail environment, with many Irish and global retailers competing for market share.

2.2.2 Study Group

The focus of this analysis was on the dietary needs of an average 38-year-old Irish female with average to below average physical activity levels (PAL 1.8). In 2023, 61.1% of females engaged in retail trade compared to just 38.9% of males (CSO, 2023). While in 2016, the average age of females in Ireland was 38 years old (CSO, 2022). In 2015, just one in four women (24%) were sufficiently active to meet the national guidelines (HSE, 2016).

2.2.3 Retailers & Retailer Products Included

The retailers included in this study were Dunnes Stores, Tesco and SuperValu. These retailers were selected based on market share. These retailers currently hold the top 69% of the market between them. Products selected for analysis were based on the food pyramid and included own brand wholemeal bread products, own brand strawberry yogurts and own brand chocolate cookies. Branded products selected for analysis were Brennans Be Good Wholemeal Delicious High Fibre Bread 600g, Glenilen Farm Live Natural Yoghurt with Strawberries 4 x 125g and Maryland Choc Chip Cookies 200g.

2.2.4 Retailer & Retailer Products Not Included

The retailers that were not included in this study were discounters such as Aldi and Lidl, as well as retailers such as Marks and Spencer's, Spar and Centra. These retailers were not selected due to the limited market share held by these retailers and would be less accurate in analysing the mean intake of Irish consumers. Products not selected for analysis were single ingredient, fresh produce such as fruit and vegetables and meat products including poultry and red meat due to the basic nutritional calculation carried out on these product types.

2.2.5 Study Range

The nutritional value of selected own brand food products from these retailers, across the budget, core and premium tiers were selected in addition to similar branded products were analysed as part of this thesis. Products were chosen based off of the tiers of the food pyramid as this is an important tool used to illustrate the array and quantities of food that should be consumed daily in order to achieve a healthy balanced diet.

2.2.6 Product Inclusions

Products selected for analysis were done so based off of the food pyramid. Processed foods with varying nutritional values were analysed in order to ensure results were more accurate. The shelves selected for analysis included shelf two which outlines wholemeal cereals and breads, pasta, potatoes and rice. The product selected from this shelf was wholemeal bread. Another shelf utilised was the third shelf of the food pyramid. This outlines dairy products such as milk, yogurt and cheese and the product selected for the analysis from this shelf was strawberry flavoured yogurt. The final shelf in which data was analysed as part of this research was the top shelf of the food pyramid. This shelf includes the products that should not be eaten in excess, including chocolate, fizzy drinks and snacks such as crisps and biscuits. The product that was analysed in this tier was chocolate cookies.

2.2.7 Product Exclusions

Certain shelves of the food pyramid were excluded due to the fresh nature of the products. Non processed foods will have the same nutritional values generated from similar databases such as Nutricalc. Therefore, it was more relevant to this thesis to analyse manufactured or processed food products that are outlined on the other tiers of the food pyramid and as such, food from the first shelf of the food pyramid which is comprised of fresh fruit and vegetables and the fourth shelf of the food pyramid which is describes the recommended intake of meat, poultry, fish, eggs, beans and nuts were excluded. The fifth tier of the food pyramid which outlines fats, spreads and oils was also not included in this analysis as all three retailers; Dunnes Stores, Tesco and Super Value offer only one tier of these products due to the basic nature of them. Therefore, no product was analysed from this tier of the food pyramid.

Chapter 3

Results

The results chapter will outline the nutritional value of selected own brand food products, across the budget, core and premium tiers, as well as branded products, based on the tiers of the food pyramid. The purpose of this is to establish whether or not there is a variance or correlation between the nutritional content and price of the product. The food pyramid illustrates the array and quantities of food that should be consumed in order to achieve a healthy balanced diet. The chapter will also provide an overview of the financial cost of each product to outline if there is a direct link between cost and the nutritional content of processed food products. The three retailer own brand products that are analysed in this chapter are Dunnes Stores, Tesco and SuperValu. These three retailers currently hold the highest market share of the retail landscape in Ireland, and each have an extensive range of own brand products and branded products on offer in their stores. Retail own brand products, which are produced and packed under the retailer's name, were traditionally seen as poorer quality, cheaper option. However, in the last two decades, the demand for own brand products has increased rapidly. The competition between branded and own brand products in the retail market has become tighter, with May 2023 being the first time that own brand products were on equal ground with branded products in market share terms. This increase in own brand products can be attributed to the rise in inflation. In the same month, inflation of grocery items rose by 16.5%, which would cause a shift in consumer spending habits.

All prepacked food products, whether branded or own brand, must display the nutritional information per 100g of the product, under EU legislation. Food business operators must display the energy value in KJ and kcal, the fat, saturated fat, carbohydrates, sugar, protein and salt quantities of the product in that order. The ingredient declaration of products containing two or more ingredients must also be clearly displayed on pack. This allows consumers to see the nutritional value of the food, but also the contents of the product in terms of additives and ingredients. This is an essential aspect of food packaging as approximately 35% of all deaths annually in Ireland have been attributed to behavioural factors, which includes poor diet. Therefore, it is important to look at the food offering in Irelands largest retailers in order to establish if affording less money for food products can be contributing to this statistic. Products are analysed based on the recommend daily intake. This value differs depending on different genders, age and activity levels of the consumer. The focus of this analysis is the reference intake levels of a 38-year-old female in Ireland with below average to average physical activity levels. The reference intake of the

macronutrients, energy value and salt and fibre quantities were based on the recommended intake per day, as set out in Table 3.1 and results were compared with the energy intake values recommended for this sample group as set out in Table 1.6.

ENERGY OR NUTRIENT REFERENCE INTAKE	
ENERGY	8,400kj/2,000kcal
TOTAL FAT	70g
SATURATES	20g
CARBOHYDRATE	260g
SUGARS	90g
PROTEIN	50g
SALT	6g

Table 3.1 The recommended energy intake for a moderately active woman. (taken from Food & Drink Europe, 2014).

3.1 Shelf One - Food Pyramid

As discussed in Chapter one, the first shelf of the food pyramid is comprised of fresh fruit and vegetables. While a very important aspect in achieving a balanced diet, these products have a natural nutritional value, meaning these are not processed or manufactured, no element is added or taken away. The basic nutritional value of each product, contained within this this shelf of the pyramid, will be calculated based on the same database such as Nutricalc. Therefore, it is more relevant to this thesis to analyse manufactured or processed food products that are described on the other tiers of the food pyramid and as such, food from this shelf will not be included in this analysis.

3.2 Shelf Two - Food Pyramid

The second shelf of the food pyramid outlines wholemeal cereals, breads, pasta, rice and potatoes. It is recommended that three to five servings a day are taken from this shelf in order to achieve a healthy diet. The products analysed will be wholegrain bread, a budget, core and premium loaf under each of the selected retailers own brand ranges, in addition to well established branded products. Wholegrain bread is seen as more beneficial than white

bread, as this is an unrefined product, meaning the wheat used will not have had the bran and the germ removed from the grain. It would be expected that carbohydrate and fibre quantities would be high in these products.

3.2.1 Dunnes Stores Own Brand- Wholemeal Bread Products

Dunnes Stores have many own brand wholemeal bread products on offer. Table 3.2 outlines the three products selected across the three tiers, including the price per product and per kg of product.

Value Tier	Dunnes Stores Basic Brown Sliced Pan 800g	99c or €1.24/ kg
Core Tier	Dunnes Stores Wholemeal Sliced Bread 800g	€1.39 or €1.74/kg
Premium Tier	Dunnes Stores Simply Better Handmade Wholemeal Sliced Bread 400g	€1.29 or €3.23/kg

Table 3.2 The products selected from Dunnes Stores three own brand tiers for tier two of the food pyramid (adapted from Dunnes Stores, 2024).

The nutritional value of these products is as set out in Table 3.3, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	Dunnes Stores Value		Dunnes Stores Core		Dunnes Stores Premium	
	Per 100g	% RI	Per 100g	% RI	Per 100g	% RI
Energy	962kJ	11.45%	932 kJ	11.1%	959kJ	11.42%
	227kcal	11.35%	221 kcal	11.05%	227kcal	11.35%
Fat	1.4g	2%	1.5g	2.14%	2.2g	3.14%
of which saturates	0.3g	1.5%	0.3g	1.5%	0.3g	1.5%
Carbohydrate	42g	16.15%	38g	14.62%	38g	14.62%
of which sugars	3g	3.33%	2.7g	3%	2.8g	3.11%
Fibre	5.3g	17.67%	7g	23.33%	6.4g	21.33%
Protein	9.5g	19%	9.9g	19.8%	10g	20%
Salt	1.1g	18.33%	1g	16.67%	0.83g	13.83%

Table 3.3 The nutritional contents of Dunnes Stores own brand wholemeal bread products, across the three tiers, value, core and premium. (adapted from Dunnes Stores, 2024).

Dunnes Stores value, core and premium wholegrain own brand products all have a very similar energy level. The core tier has the lowest calorific value by 0.3% of the calorific value compared to the value and premium tier which are equal in calories. The premium tier is higher in fat, but as all three tiers are equal in saturated fats, this means that the ratio of saturated fats to total fat is lower in the premium tier and highest in the value tier. The value tier is highest in carbohydrates, with the core and premium tier at the same level in this instance. But the premium tier has the highest ratio of sugars to carbohydrates, with the core tier wholemeal bread containing the lowest ratio. In terms of fibre, these products are high in fibre, but the core tier has the highest amount present, and the value tier has the lowest. Protein values are closely similar across the three tiers. Finally, the premium tier is lowest in salt, while the value tier is the highest. Overall, in terms of nutritional value, it could be suggested to rank these tiers as the core tier as the most beneficial, and the value tier as least beneficial.

The ingredient declarations of each of the three Dunnes Stores own brand wholemeal bread products are set out in Table 3.4 in the order of highest quantity to lowest quantity.

Dunnes Stores Own Brand Wholemeal Bread Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	Water, Fortified Wheat Flour Wholemeal Wheat Flour Yeast Salt Soya Flour Barley Malt Flour Rapeseed Oil Emulsifiers: Mono- and Diacetyl tartaric Acid Esters of Mono- and Diglycerides of Fatty Acids, Mono- and Diglycerides of Fatty Acids Preservative: Calcium Propionate Flour Treatment Agent: Ascorbic Acid Enzymes Palm Fat	Wholemeal Wheat Flour Water Yeast Salt Soya Flour Emulsifier: Mono- and Diacetyl tartaric Acid Esters of Mono- and Diglycerides of Fatty Acids, Mono- and Diglycerides of Fatty Acids Barley Malt Flour Rapeseed Oil Preservative: Calcium Propionate Flour Treatment Agent Ascorbic Acid Enzymes Palm Fat	Wholemeal Wheat Flour Water Cracked Wheat Yeast Rapeseed Oil Wheat Flour Calcium Sulphate Flour Treatment Agent: Ascorbic Acid Wheat Starch Enzymes Salt Fermented Wheat Flour Wheat Gluten Soya Flour Topping: Rice Flour
Claims on Pack	Naturally low in fat Low sugar Free from hydrogenated fat Suitable for vegans.	Suitable for vegans.	Free from hydrogenated fat Low fat High in fibre Free from preservatives Suitable for vegetarians.

Table 3.4 The ingredient declarations and nutritional claims of Dunnes Stores Own Brand wholemeal bread products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Dunnes Stores, 2024).

The premium tier product has the cleanest labels. There are no emulsifiers or preservatives unlike the other products from the other two tiers. The value tier however includes the use

of fortified wheat flour which gives additional calcium carbonate, iron, niacin and thiamine to the consumer. Other than this, the value tier and core tier have very similar ingredient declaration, with the quantities of water and emulsifiers differing. The core product has the highest quantity of emulsifiers based on the positioning in the ingredient declaration, however, this is the product with the least ingredients. The claims included on each pack are also outlined. The premium product has the most nutritional claims. It should be noted that the value tier has claimed low in sugar, however out of the three products analysed, this product had the highest sugar. Additionally with the high in fibre claim on the premium tier. The core product has the highest fibre amount and lowest sugar quantities per 100g of product than any of the products. Therefore, nutritional claims must be analysed carefully as these are not a mandatory element and not all products will display all applicable claims. Overall, based on the ingredient declaration, the premium product would be recommended as the most beneficial product due to the clean label, leading to the impression that this product is more natural.

3.2.2 Tesco Own Brand - Wholemeal Bread Products

The current own brand wholemeal bread products selected for analysis are outlined in Table 3.5, including the price per product and per kg of product.

Value Tier	Tesco Family Brown Sliced Pan 800g	€0.99 or €1.24/kg
Core Tier	Tesco Farmhouse Wheaten 500g	€1.10 or €2.20/kg
Premium Tier	Tesco Finest Super Grained Loaf 600g	€2.15 or €3.58/kg

Table 3.5 The products selected from Tesco’s three own brand tiers for shelf two of the food pyramid (adapted from Tesco, 2024).

The nutritional value of these products is as set out in Table 3.6, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	Tesco Value		Tesco Core		Tesco Premium	
	Per 100g	% RI	Per 100g	% RI	Per 100g	% RI
Energy	974kJ	11.59%	920kJ	10.95%	1331kJ	15.85%
	230kcal	11.5%	218kcal	10.9%	317kcal	15.85%
Fat	1.1g	1.6%	2.2g	3.14%	7.7g	11%
Of which saturates	0.3g	1.5%	0.6g	3%	1g	5%
Carbohydrate	41.7g	16%	37.6g	14.5%	43.9g	16.9%
of which sugars	2.7g	3%	4.6g	5%	1.5g	1.67%
Fibre	7.2g	24%	4.5g	15%	10.4g	34.67%
Protein	9.8g	19.6%	9.6g	19.2%	12.8g	25.6%
Salt	0.9g	15%	0.88g	14.6%	0.92g	15.33%

Table 3.6 The nutritional contents of Tesco’s own brand wholemeal bread products, across the three tiers, budget, core and premium. (adapted from Tesco, 2024).

The premium Tesco wholemeal bread has a higher calorific value compared to the other two tiers. This product also has a much higher fat value. However, this is attributed to unsaturated fats, as only 1g of these were saturated fats. Again, this product is high in carbohydrates when compared to the value and core tier, but the sugar content is very low. The core tier has the highest content of sugars, while this is still a low value. The core tier also has the lowest fibre value. The premium tier is high in fibre, over double the amount available in the core tier. The salt value across the three products is similar, with the value product just slightly more than the other two. Based on the nutritional table alone, it could be recommended that the premium tier is the most beneficial, and the value tier is the least beneficial.

Tesco Own Brand Wholemeal Bread Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	Wholemeal Wheat Flour Water Fortified Wheat Flour Yeast Wheat Gluten Salt Soya Flour Emulsifiers: Mono- and Diacetyl Tartaric Acid Esters of Mono- and Diglycerides of Fatty Acids, Sodium Stearoyl-2-Lactylate, Mono- and Diglycerides of Fatty Acids Preservative: Calcium Propionate Palm Oil Flour Treatment Agent: Ascorbic Acid Rapeseed Oil	Buttermilk (47%) Fortified Wheat Flour Wheatgerm (4.5%) Wheat Bran (4%) Sugar Raising Agents: Sodium Carbonate, Potassium Carbonate Treacle Oats (1%) Spirit Vinegar Preservatives: Potassium Sorbate, Calcium Propionate Palm Oil Water Salt Rapeseed Oil Emulsifier: Mono- and Diglycerides of Fatty Acids, Mono- and Di-Acetyl Tartaric Acid Esters of Mono- and Diglycerides of Fatty Acids Wheat Gluten	Fortified Wheat Flour Water Yeast Rye Flour Sunflower Seed (4.5%) Linseed (4.5%) Millet (4%) Wheat Gluten Wheat Flour Pumpkin Seed (3%) Malted Wheat Flakes Poppy Seeds (2%) Barley Malt Syrup Brown Sugar Salt Rapeseed Oil Sourdough Culture Acidity Regulator: Acetic Acid Flour Treatment Agent: Ascorbic Acid
Claims on Pack	No claims on pack	Suitable for vegetarians	High fibre Source of protein

Table 3.7 The ingredient declarations and nutritional claims of Tesco’s own brand wholemeal bread products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Tesco, 2024).

Based on the ingredient declaration, it is clear to see why the premium tier product was more nutritionally beneficial. The seeds in the ingredient declaration will be contributing to the presence of high calories, good fats and protein in the product. All three products are produced with fortified flour which is beneficial for the consumer. However, the core product is produced using treacle which could be contributing to high sugar values. The premium product also has two nutritional claims, which are high fibre and a source of protein. The core tier product contains wheat germ and wheat bran present which is also

beneficial. Based on the nutrition and ingredient declarations, it could be suggested that the premium tier is the most beneficial, while the value tier is the least beneficial.

3.2.3 SuperValu Own Brand - Wholemeal Bread Product

The SuperValu own brand wholemeal bread products selected for analysis are outlined in Table 3.8, including the price per product and per kg of product. While this category of product has not been marketed according to premium, core and value tier, a tier was assigned based on the price of the product.

Value Tier	SuperValu Wholemeal Brown Bread 800g	€1.39 or €1.74/kg
Core Tier	SuperValu Brown Sliced Pan 800g	€1.55 or €1.94/kg
Premium Tier	SuperValu Stoneground Wholewheat Bread 454g	€0.99 or €2.18/kg

Table 3.8 The products selected from SuperValu’s three own brand tiers for tier two of the food pyramid (adapted from SuperValu, 2024).

The nutritional value of these products is as set out in Table 3.9, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	SuperValu Value		SuperValu Core		SuperValu Premium	
	Per 100g	% RI	Per 100g	% RI	Per 100g	% RI
Energy	971kJ	11.6%	971kJ	11.6%	1025 kJ	12.2%
	230kcal	11.5%	230kcal	11.5%	243kcal	12.15%
Fat	1.5g	2%	1.5g	2%	2.3g	3.29%
Of which saturates	0.4g	2%	0.4g	2%	0.7g	3.5%
Carbohydrate	40g	15.4%	40g	15.4%	42.4g	16.31%
of which sugars	3.2g	3.5%	3.2g	3.5%	1.6g	1.78%
Fibre	6g	20%	6g	20%	7.6g	25.33%
Protein	9.8g	19.6%	11g	22%	9g	18%
Salt	0.9g	15%	1g	16.7%	1.6g	26.7%

Table 3.9 The nutritional contents of SuperValu’s own brand wholemeal bread products, across the three tiers, budget, core and premium. (adapted from SuperValu, 2024).

The nutritional values of the SuperValu value and core tier products are exactly the same, with two exceptions. The protein value is higher in the core product by 1.2g. Secondly, the salt value is also higher in the core product by 0.1%. Based on this, it could be said that these are very equal in terms of being beneficial. The calorie content of the premium tier is also similar to the other two tiers. However, the fat is higher in the premium product, but the saturated fat to fat ratio is lower than the cheaper products. Again, carbohydrates are higher by 2.3g, but the sugar quantity is almost half. Despite these benefits, the premium product is the lowest in protein, and the highest in salt by almost 10% of the daily recommended intake. Given where the product is placed on the food pyramid, the carbohydrate values and fibre values are important for this product, therefore it could be suggested that the premium tier is most beneficial here.

SuperValu Own Brand Wholemeal Bread Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	Wholemeal Wheat Flour (62%) Water Wheat Gluten Yeast Salt Soya Flour Emulsifiers (Mono and Diacetyl Tartaric Acid Esters of Mono- And Diglycerides of Fatty Acids, Sodium Stearoyl-2-Lactylate, Mono- And Diglycerides of Fatty Acids) Fortified Wheat Flour Preservative: Calcium Propionate Palm Fat Flour Treatment Agent: Ascorbic Acid Rapeseed Oil	Wholemeal Wheat Flour (62%) Water Wheat Gluten Yeast Salt Soya Flour Emulsifiers: Mono- And Diacetyl Tartaric Acid Esters of Mono- And Diglycerides of Fatty Acids, Sodium Stearoyl-2-Lactylate, Mono- And Diglycerides of Fatty Acids Fortified Wheat Flour Palm Fat Flour Treatment Agent: Ascorbic Acid Rapeseed Oil	Fortified Wheat Flour Buttermilk (38%) Coarse Cut Wholewheat (29%) Raising Agents: Sodium Carbonates, Diphosphates Kibbled Wheat Vegetable Oil (Palm Oil, Rapeseed Oil) Salt Preservative: Calcium Propionate
Claims on Pack	High in fibre Low in fat Low in sugar Suitable for vegetarians	Irish made High in fibre Suitable for vegetarians.	High in fibre Low in fat Low in sugar Yeast free Suitable for vegetarians

Table 3.10 The ingredient declarations and nutritional claims of SuperValu’s own brand wholemeal bread products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from SuperValu, 2024).

The only variation between the value and core tier in SuperValu is the presence of a preservative in the value tier. All other ingredients are the same and in the same order, so approximately similar quantities. The premium tier has a shorter ingredient declaration, with the highest percentage of ingredient used being the fortified wheat flour. Based on the ingredients, claims and nutrition, it could be recommended that the premium tier is more beneficial, while the value is least beneficial.

3.2.4 Branded Wholemeal Bread Product

Brennans Be Good Wholemeal Delicious High Fibre Bread 600g is the branded product most comparable to the own-brand products whose nutritional data was analysed above. It is currently sold for €2.03 or €3.38/kg. The nutritional value of this product is as set out in Table 3.11 detailing the macro nutrient content, overall energy contribution and salt level.

	Per 100g	% RI
Energy	895kJ	10.65%
	212kcal	10.6%
Fat	1.4g	2%
of which saturates	0.1g	0.5%
Carbohydrate	37.1g	14.27%
of which sugars	1.7g	1.89%
Fibre	6.6g	22%
Protein	9.4g	18.8%
Salt	1g	16.7%

Table 3.11 The nutritional contents of Brennans Be Good Wholemeal Delicious High Fibre Bread 600g (adapted from Dunnes Stores, 2024).

This branded wholemeal bread is similar to the calorific values as seen in the products above. The quantity of fat and saturated fat is very low. There is a good source of carbohydrates, with only 1.7g of the 37.1g present being sugars. This product also has a high fibre value as expected, but additionally, has a reasonable amount of protein.

Branded Wholemeal Bread Product	
Brand	Brennans Be Good Wholemeal Delicious High Fibre Bread 600g
Ingredients	Wholemeal Wheat Flour (57%) Water Yeast Salt Vegetable Oil (Rapeseed) Soya Flour Emulsifiers: (Diacetyl tartaric acid ester of mono- and diglycerides, Sodium stearyl-2-lactylate) Flour Treatment Agent: Ascorbic Acid (Vitamin C) Vegetable Fat (Palm)
Claims on Pack	60 calories per slice High fibre Low fat, Suitable for vegetarians No added sugar.

Table 3.12 The ingredient declarations and nutritional claims of Brennans Be Good Wholemeal Delicious High Fibre Bread 600g. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Dunnes Stores, 2024).

Unlike the own brand counterparts, the branded wholemeal bread is not produced with fortified flour. 57% of the product is wholemeal flour which is beneficial as a source of fibre and carbohydrates. However, unlike some of the premium own brand products, there are emulsifiers and flour treatment agents used in the production of this product. In terms of on-pack claims, the product is high in fibre and has no added sugars. The content of sugar per 100g of this product 1.7g or 1.89% of the recommended intake. This is very low and given that no sugar was added, we can assume that this is accounting for naturally occurring sugars only.

3.2.5 Overall Analysis of Retail Own Brand Wholemeal Products

Table 3.13 illustrates the comparison of the nutritional value of all own brand wholemeal bread products analysed from the value or basic tier, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

Wholemeal Bread Value Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	962KJ	974KJ	971KJ	969KJ
Energy kcal	227kcal	230kcal	230kcal	229kcal
Fat	1.4g	1.1g	1.5g	1.33g
of which saturates	0.3g	0.3g	0.4g	0.33g
Carbohydrate	42g	41.7g	40g	41.23g
of which sugars	3g	2.7g	3.2g	2.97g
Fibre	5.3g	7.2g	6g	6.17g
Protein	9.5g	9.8g	9.8g	9.7
Salt	1.1g	0.9g	0.9g	0.97g
Cost € per kg	€1.24	€1.24	€1.74g	€1.41
Cost € per 100g	€0.12	€0.12	€0.17g	€0.14

Table 3.13 The nutritional value of all own brand wholemeal bread products analysed from the value or basic tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

The value tier wholemeal bread products are very similar upon observation of the nutritional contents side by side. The most obvious difference between the three retailer's offering is the Fibre content of the Tesco value product. This product has 1g more fibre per 100g of product compared to the SuperValu value range and 1.8g more fibre than the Dunnes Stores value product. Overall, there are no outliers that could potentially skew the data. In terms of cost, the value products from Tesco and Dunnes Stores are the same price, while the SuperValu product is more expensive by fifty cents per kg of product.

Wholemeal Bread Core Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	932KJ	920KJ	971KJ	941KJ
Energy kcal	221kcal	218kcal	230kcal	223kcal
Fat	1.5g	2.2g	1.5g	1.73g
of which saturates	0.3g	0.6g	0.4g	0.43g
Carbohydrate	38g	37.6g	40g	38.53g
of which sugars	2.7g	4.6g	3.2g	3.5g
Fibre	7g	4.5g	6g	5.83g
Protein	9.9g	9.6g	11g	10.17g
Salt	1g	0.88g	1g	0.96g
Cost € per kg	€1.74	€2.20	€1.94	€1.96
Cost € per 100g	€0.17	€0.22	€0.19	€0.20

Table 3.14 The nutritional value of all own brand wholemeal bread products analysed from the core tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

On comparison of the three retailers' own brand wholemeal bread from the core range, there are noticeable differences between the three retailers on this tier. The SuperValu product is higher in calories per 100g of the product. The Tesco product is the lowest in calories, however the Dunnes Stores product contains only three more calories per 100g. The Tesco core product has the highest quantity of fat at 2.2g, while Dunnes Stores and SuperValu both only have 1.5g of fat. Looking at this even closer, Dunnes Stores wholemeal bread product on the core tier has the lowest amount of saturated fats with only 0.3g out of the 1.5g of fat sourced from saturated fats. The SuperValu product has 0.4g of saturated fat out of the 1.5g of fat contained in the product. Tesco's core product has the highest ratio of saturated fats to fat with 0.6g present in the product. However, it is worth noting that this product, across all three retailers is low in saturated fats as would be expected for product of this nature. In terms of carbohydrates, the SuperValu product has the highest amount of carbohydrates.

Dunnes Stores has less carbohydrates than the SuperValu product but more than the Tesco product. In terms of sugars, the core Tesco product has the highest quantity of sugars present, with 4.6g. This has driven the average of the three retailers core product sugar value up. The Dunnes Stores product has the highest fibre value at 7g followed closely by SuperValu at 6g. Again, Tesco has the lowest amount of fibre with only 4.5g present. However, the Tesco product is the lowest in salt with the Dunnes Stores and SuperValu products being even at 1g per 100g of product. In terms of cost, the cheapest product is the Dunnes Stores product at €1.74 per kg. SuperValu follows closely at €1.94 per kg. Lastly the Tesco product is the most expensive at €2.20 per kg.

Wholemeal Bread Premium Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	959KJ	1331KJ	1025KJ	1105KJ
Energy kcal	227kcal	317kcal	243kcal	262kcal
Fat	2.2g	7.7g	2.3g	4.07g
of which saturates	0.3g	1g	0.7g	0.67g
Carbohydrate	38g	43.9g	42.4g	41.43g
of which sugars	2.8g	1.5g	1.6g	1.97g
Fibre	6.4g	10.4g	7.6g	8.13g
Protein	10g	12.8g	9g	10.6g
Salt	0.83	0.92	1.6g	1.12g
Cost € per kg	€3.23	€3.58	€2.18	€3.00
Cost € per 100g	€0.32	€0.36	€0.22	€0.30

Table 3.15 the nutritional value of all own brand wholemeal bread products analysed from the premium tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

Upon analysing the three retailers premium tier of wholemeal bread products, the Tesco product has the highest nutritional values across all nutrients with the exception of sugars and salt. Starting with energy, the Dunnes Stores premium product has only 959KJ or 227kcal per 100g of product. This is much less than the SuperValu product which contains 1025KJ or 243kcal per 100g of product. The Tesco premium wholemeal bread, as stated, has the highest energy content, at 1331KJ or 317kcal per 100g of product. This significant difference between the energy values, can be accounted for upon a closer look at the macro nutrients of each product. The Tesco product has the highest fat content at 7.7g per 100g of product, while the Dunnes Stores product has 2.2g of fat per 100g and the SuperValu premium wholemeal bread product has 2.3g a fat per 100g. However, the Tesco product has the lowest ratio of saturated fats to fats, with only 1g of saturated fat. The Dunnes Stores premium wholemeal bread has the highest amount of sugars with over 1.2g more than the other two retailers' products. In terms of fibre, the Tesco tier has the highest amount of fibre at 10.4g per 100g. It additionally has the highest protein quantities at 12.8g, compared to 10g in Dunnes Stores product and 9g in the SuperValu premium product. The SuperValu product is the highest in salt, at 1.6g. The difference between the nutritional value of these three retailers' products can be accounted for in the ingredient decorations. The Tesco product is much higher in energy, fat and protein due to the presence of seeds in the recipe. Seeds are a great source of unsaturated fats and protein, and therefore this product would be beneficial for the consumer.

Wholemeal Bread Own Brand vs Branded				
Nutrient	Value Tier Mean	Core Tier Mean	Premium Tier Mean	Branded
Energy KJ	962KJ	941KJ	1105KJ	895KJ
Energy kcal	227kcal	223kcal	262kcal	212kcal
Fat	1.4g	1.73g	4.07g	1.4g
of which saturates	0.3g	0.43g	0.67g	0.1g
Carbohydrate	42g	38.53g	41.43g	37.1g
of which sugars	3g	3.5g	1.97g	1.7g
Fibre	5.3g	5.83g	8.13g	6.6g
Protein	9.5g	10.17g	10.6g	9.4g
Salt	1.1g	0.96g	1.12g	1g
Cost € per KG	€1.24	€1.96	€3.00	€1.74
Cost € per 100g	€0.12	€0.20	€0.30	€0.17

Table 3.16 The nutritional value of all own brand wholemeal bread products analysed from the value, core and premium tiers in comparison to a selected branded product. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

In comparing the mean values of each of the retailer's value, core and premium wholemeal bread products to the branded product selected, the branded product does not match up directly with one of the tiers. In terms of energy, the branded product is most similar to the core tier mean, with 212kcal per 100g in the branded product, compared to 223kcal as the mean energy value found in the core wholemeal bread products. The fat quantity of the branded product is equal to the mean fat value calculated for the basic or value tier of the retailer's own brand wholemeal bread, at 1.4g. However, the ratio of saturated fats to fat is lower in the branded product than the value mean. Carbohydrates in the branded product are similar to the calculated mean carbohydrate value of the core tier. The premium tier mean for sugars is the closest match to the branded quantity of sugar. The branded product and the mean premium product both have lower sugar values than the mean value tier and the mean core tier. The core tier has the most similar fibre value to the branded product, while the value tier has only 0.1g less fibre than the branded product. Additionally, the salt value calculated as the mean salt for the value tier has 1.1g of salt present compared to 1g in the

branded product. In terms of cost, the branded product is priced between the valued tier and the core tier. In terms of cost and nutritional quantity, the branded product is most similar to the value tier and is least similar to the premium tier.

In terms of statistical significance, each energy value, macronutrients and micronutrients were analysed between each of the three tiers using the mean value calculated across the three retailers. In terms of energy (KJ), the p value calculated between the mean own brand value and core tiers was $p=0.15$. The p value calculated between the core and premium tier was $p=0.27$. While the p value calculated between the value and premium tier had the highest p value at $p=0.3$. Overall, the p values calculated for the energy in KJ was not tested as statistically significant. However, there is some correlation between the price and the energy content of the wholemeal bread products, as visible in Figure 3.1 below.

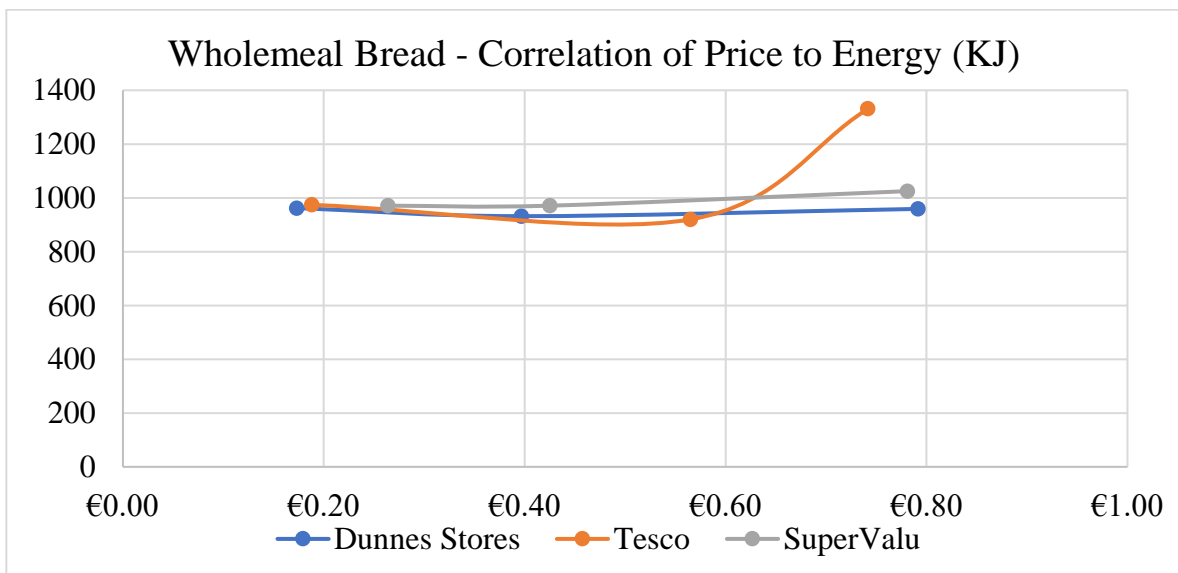


Figure 3.1 The correlation of the energy content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

Dunnes Stores is the only retailer in which the energy value does not increase with price. The core product is the lowest in energy content while the premium is the highest. SuperValu has the most linear incline of energy content in correlation to price. Each increase in price is followed by an increase in energy content. Tesco has the highest increase in energy value per tier. As the energy expressed as kcal is the same as energy in KJ, this can be presumed as the same.

For the fat content, the p value calculated between the mean own brand value and core tiers was $p= 0.31$. The p value calculated between the core and premium tier was $p=0.27$. While the p value calculated between the value and premium tier had the lowest p value at $p=0.21$. Overall, the p values calculated for the fat content was not tested as statistically significant. Despite this, there is a positive correlation across the three retailers between the price and the fat content of the wholemeal bread products, as displayed in Figure 3.2 below.

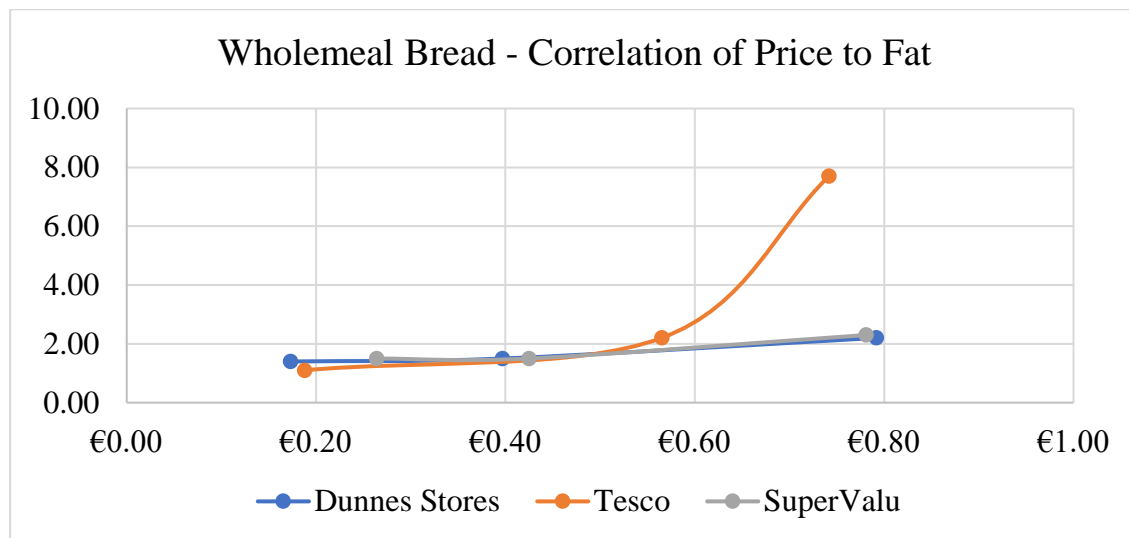


Figure 3.2 The correlation of the fat content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

Tesco, similar to the energy content, has the highest increase of fat content to increasing price, a positive correlation. SuperValu has a much smaller increase, with the value and core product, in terms of fat being equal, and then the premium product increasing with the price. Dunnes Stores has an increase in price, with a very gradual increase in fat content, which is a positive correlation.

For the saturated fat content, the p value calculated between the mean own brand value and core tiers was $p= 0.34$. The p value calculated between the core and premium tier was $p=0.35$. While the p value calculated between the value and premium tier had the lowest p value at $p=0.18$. Overall, the p values calculated for the saturated fat content was not tested as statistically significant. The correlation between the price and the saturated fat content of the wholemeal bread products, is shown in Figure 3.3 below.

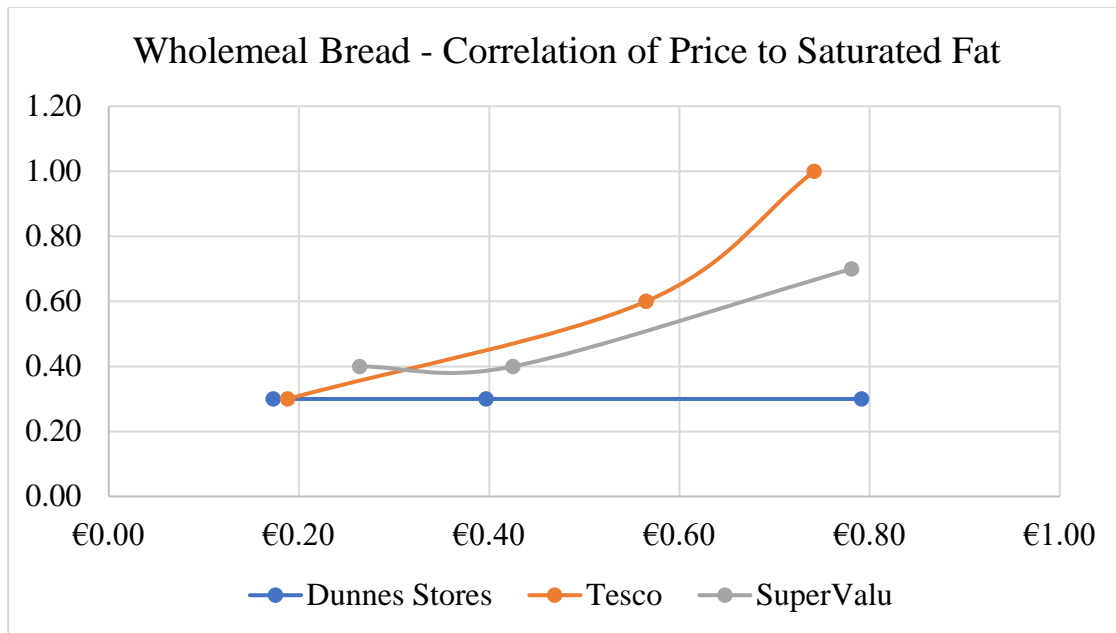


Figure 3.3 The correlation of the saturated fat content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

Dunnes Stores has an increase in price, but the saturated fat content remains the same. This shows no correlation between cost and nutritional quantity. Tesco products have a steep, positive incline. This is a strong correlation between the increase of saturated fats with price. SuperValu products, similar to the fat quantities, the saturated fats of the value and core product, are equal, and then the saturated fats of the premium product increases with the price.

In terms of the carbohydrates content, the p value calculated between the mean own brand value and core tiers was $p=0.049$, illustrating that there is a statistical difference between the carbohydrate value of the value tier and the core tier. The p value calculated between the core and premium tier was $p=0.21$. While the p value calculated between the value and premium tier had the highest p value at $p=0.92$. These p values indicate that the variation between carbohydrate in the core and premium tiers, and the value and premium tiers, are not statistically significant. This shows that there is a difference between the value and core tier, which is evident in the correlation between the price and the carbohydrate content of the wholemeal bread products, visible in Figure 3.4 below.

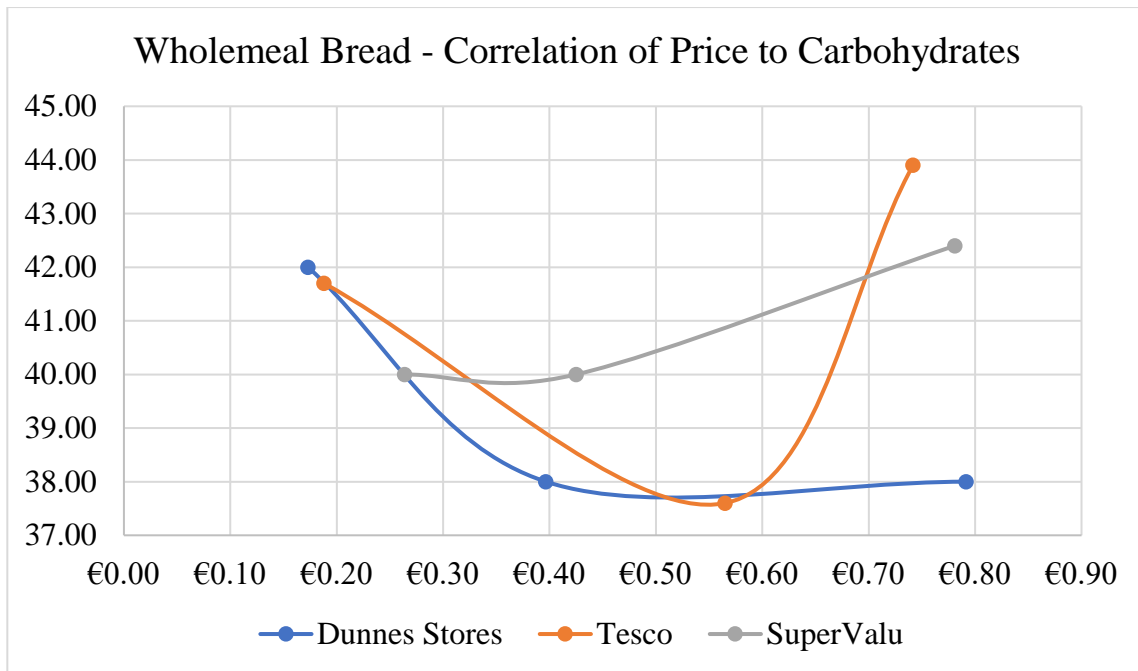


Figure 3.4 The correlation of the carbohydrate and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

In Figure 3.4, it is illustrating the negative correlation of the carbohydrate content and price of the Dunnes Stores wholemeal bread products. The content of carbohydrate decreases with price. For the Tesco products, the carbohydrate content fluctuates with price, with the core tier having a lower content of carbohydrates than the value or premium tiers. SuperValu meanwhile has a more positive correlation. The value and core have the same carbohydrate values but this increases in the premium tier.

Next is the sugar content. The p value calculated between the mean own brand value and core tiers was $p=0.41$. The p value calculated between the core and premium tier was $p=0.09$. While the p value calculated between the value and premium tier had the lowest p value at $p=0.08$. Overall, the p values calculated for the sugar content was not tested as statistically significant. Additionally, the correlation between the price and the sugar content of the wholemeal bread products was not found as significant as shown in Figure 3.5.

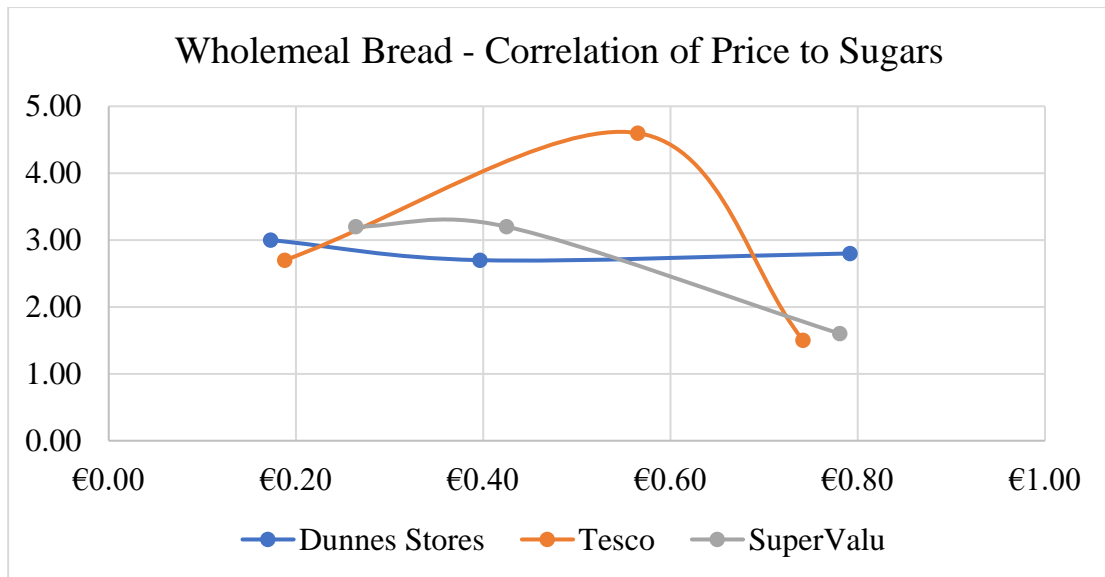


Figure 3.5 The correlation of the sugar content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

There is no correlation between price and sugar content in Dunnes Stores wholemeal bread own brand products. The sugar level fluctuates from highest in the cheapest tier, and lowest in the core tier. In the Tesco own brand wholemeal bread products, this is similar to Dunnes Stores, except the most expensive, premium tier has the lowest sugar content, and the core tier has the highest. SuperValu value and core products have the same sugar values but this decreases in the premium tier.

For the fibre content, the p value calculated between the mean own brand value and core tiers was $p=0.73$. The p value calculated between the core and premium tier had the lowest p value at $p=0.179$. While the p value calculated between the value and premium tier was $p=0.21$. Overall, the p values calculated for the fibre content was not tested as statistically significant. Additionally, the correlation between the price and the fibre content of the wholemeal bread products was not found as significant as shown in Figure 3.6.

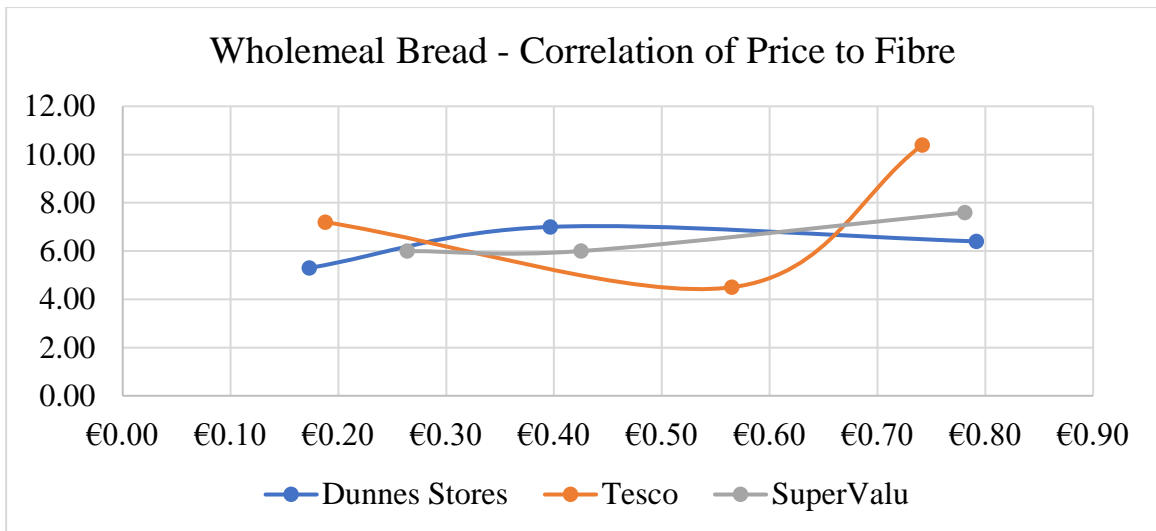


Figure 3.6 The correlation of the fibre content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

There is no correlation between the price of the own brand wholemeal bread and the fibre content for any of the retailers analysed. Dunnes Stores has the lowest fibre content in the value tier and the highest in the core tier product. The Tesco own brand products have the lowest fibre value in the core product and the highest in the premium tier. SuperValu value and core products have the same fibre content but this increases in the premium tier.

In terms of protein, the p value calculated between the mean own brand value and core tiers was the lowest p value at $p=0.34$. The p value calculated between the core and premium tier was the highest p value at $p=0.73$. While the p value calculated between the value and premium tier was $p=0.47$. Overall, the p values calculated for the protein content was not tested as statistically significant. Additionally, the correlation between the price and the protein content of the wholemeal bread products is illustrated in Figure 3.7.

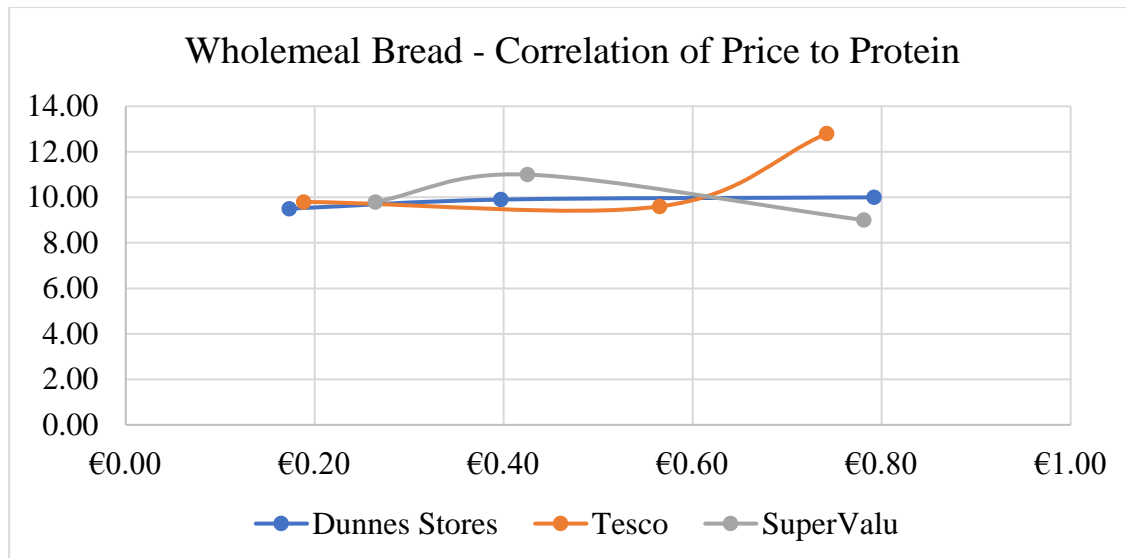


Figure 3.7 The correlation of the protein content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

There is a positive correlation between the protein content and price of the Dunnes Stores wholemeal bread own brand products. The value tier had the lowest protein content, and the premium had that highest protein content. The Tesco own brand wholemeal bread products had no correlation in terms of protein and price. There is a decline in protein from the value to the core, that fluctuates to a much higher protein content in the premium tier. Finally, the SuperValu own brand wholemeal bread products also fluctuate in protein content and price. The premium product has the lowest protein content, and the core product has the highest protein content.

Lastly, for the salt content, the p value calculated between the mean own brand value and core tiers was the highest p value at $p=0.57$. The p value calculated between the core and premium tier was $p=0.45$. While the p value calculated between the value and premium tier was $p=0.40$. Overall, the p values calculated for the salt content was not tested as statistically significant. However, there is a slight correlation between the price and the salt content of the wholemeal bread products as illustrated in Figure 3.8.

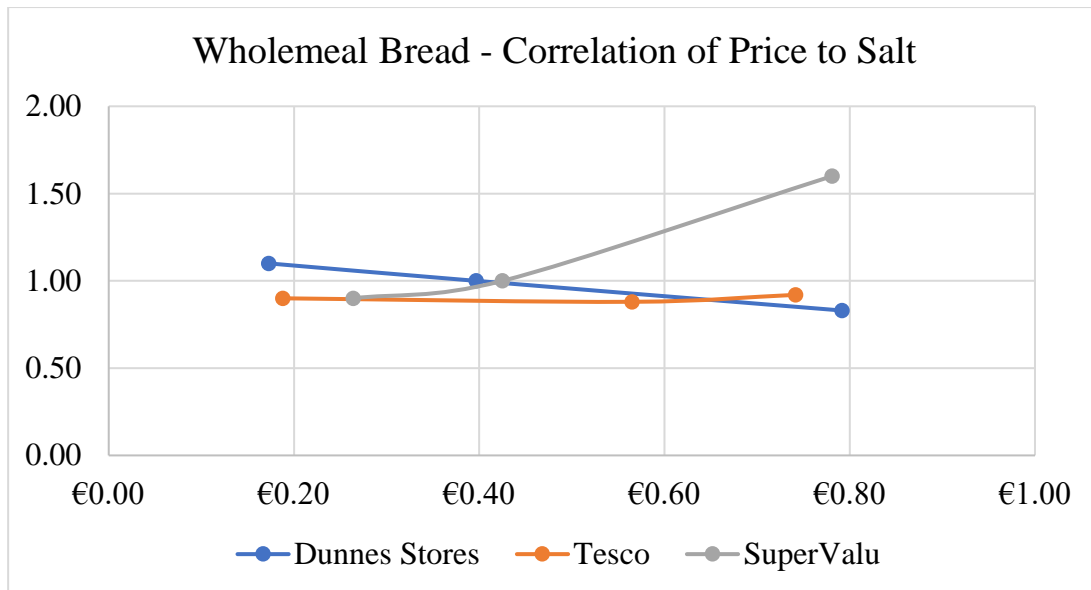


Figure 3.8 The correlation of the salt content and price of Dunnes Stores, Tesco and SuperValu own brand wholemeal bread products across each tier.

The salt content in the Dunnes Stores own brand wholemeal bread products have a negative correlation. The salt content reduces as the price increase. The Tesco own brand wholemeal bread products fluctuate in terms of salt and price. The core tier is the lowest in salt, while the premium product has the highest salt content. Finally, SuperValu have a positive correlation. As the price increase, so too does the salt content. This is the inverse of the Dunnes Stores products.

3.3 Shelf Three - Food Pyramid

The third shelf of the food pyramid outlines dairy products such as milk, yogurt and cheese. The product selected for the analysis from this shelf is strawberry flavoured yogurt. Yogurt is a big part of the overall Irish diet. According to Bord Bia, in 2023, exports of Irish yogurt was valued at €25 million (Bord Bia , 2024). In 2021, Ireland was the second highest consumer of yogurt in Europe, second only to France (Teagasc, 2021). According to Glanbia, in the dairy yogurt category, strawberry was the leading flavour in global new product launches between July 2019 and June 2020 (Glanbia, 2021).

3.3.1 Dunnes Stores Own Brand – Strawberry Yogurt Products

Table 3.17 outlines the three yogurt products selected across the three tiers, including the price per product and per kg of product.

Value Tier	No Product comparable	N/A
Core Tier	Dunnes Stores Rich & Creamy Senga Strawberry Yogurts 500g (4x125g)	€1.99 or €3.98/kg
Premium Tier	Dunnes Stores Simply Better Rich & Creamy Yogurt with Irish Strawberries 450g	€2.69 or €5.98/kg

Table 3.17 The products selected from Dunnes Stores three own brand tiers for tier three of the food pyramid (adapted from Dunnes Stores, 2024).

The nutritional value of these products is as set out in Table 3.18, detailing the macro nutrient content, overall energy contribution, as well as the calcium and salt level.

	Dunnes Stores Core		Dunnes Stores Premium	
	Per 100g	% RI	Per 100g	% RI
Energy	445 kJ	5.3%	586kJ	6.98%
	106kcal	5.3%	140kcal	7%
Fat	2.8g	4%	7.1g	10.14%
Of which saturates	2g	10%	4.9g	24.5%
Carbohydrate	15g	5.8%	16g	6.15%
of which sugars	15g	16.7%	14g	15.56%
Fibre	0.9g	3%	0.8g	2.67%
Protein	4.4g	8.8%	2.8g	5.6%
Salt	0.14g	2.3%	0.08g	3.48%
Calcium	148mg	19.7%	N/A	N/A

Table 3.18 The nutritional contents of Dunnes Stores own brand strawberry yogurt products, across the core and premium tiers. (adapted from Dunnes Stores, 2024).

The value tier offering of strawberry yogurt in Dunnes Stores is a fat free strawberry yogurt drink. This product is not comparable and will cause the results to be skewed. Therefore, no product was analysed from Dunnes Stores in this category for the value tier.

Upon analysing the core offering from Dunnes Stores and the premium tier product, there are clear variations in the nutritional value between both products. The premium product is over 100KJ per 100g more than the core products. However, this is only a difference of 1.7% of the recommended daily intake of calories. The premium yogurt is also higher in fat and saturated fat than the cheaper core product, with fat in the premium product accounting for 63.9kcal of the energy intake. The core product on the other hand is lower in fat with 2.8g per 100g of product. However, the core product fat value accounts for 39.86% of the total energy value of the product, which is also high. The ratio of fats to saturated fats is higher in the Dunnes Stores core product than the premium product, however. In terms of carbohydrates, the premium product has 16g per 100g where the core product has 15g, so

they are very similar in this aspect. Sugars on the other hand are higher in the cheaper core product, with 15g compared to the 14g of sugars in the premium product. The core yogurt is a better source of protein than the premium product, with 8.8% of the recommended intake of protein being sourced per 100g of this product. The salt values in both of these products are low. Calcium is an important micronutrient sourced through yogurt, however, this value is not given for the premium product, so it is not possible to compare the products in this respect.

Dunnes Stores Own Brand Strawberry Yogurt Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	No product suitable for analysis	Irish Whole Milk Senga Strawberries (15%) Sugar Skimmed Milk Powder Whey Protein Concentrate Irish Cream Cornflour Concentrated Lemon Juice Natural Flavouring Acidity Regulator: Sodium Citrates Concentrated Elderberry Juice Live Yogurt Cultures	Irish Milk Irish Strawberry Compote [Irish Strawberries, Sugar, Gelling Agent: Pectin] Irish Cream (11%) Sugar Skimmed Milk Powder Live Yogurt Cultures [Bifidobacterium and Lactobacillus Acidophilus]
Claims on Pack	No product suitable for analysis	Source of calcium Source of protein Free from artificial colours, flavours and preservatives Suitable for vegetarians.	Wexford Made Free from artificial colours, flavours and preservatives

Table 3.19 The ingredient declarations and nutritional claims of Dunnes Stores own brand strawberry yogurt products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Dunnes Stores, 2024).

The observed variation between the nutritional content of the core strawberry yogurt and the premium strawberry yogurt from Dunnes Stores can be further explained by analysing the ingredient declarations of both products. The main ingredient in both products is Irish milk. Then, in the core product sugar is the second highest ingredient utilised. This could account for the high sugar content of the product. However, the core product uses strawberries as an ingredient on their own. While this will also bring the sugar content up due to fructose in the fruit, this is not considered added sugar. In the premium product, a strawberry compote is used to add the strawberry flavour to the yogurt. This compote is made from strawberries, sugar and the food additive pectin. The core product had higher protein value than the premium product and the added whey protein concentrate added to the core product could account for this. The variation on the fat content can be attributed to the placement of cream in both ingredient declarations. The core product uses less cream than the premium product, accounting for the lower fat content. Both products contain live yogurt cultures which are beneficial for the gut microbiome. In terms of claims, the core product has more nutritional claims on pack. The product is a source of protein and calcium. Both products are free from artificial colours, flavours and preservatives, however, the core product contains acidity regulators, natural flavourings and in general has more ingredients in the product than the premium product. Overall, the core product could be viewed as the better source of protein and calcium, but overall, the premium product has less sugar and has a cleaner label than the core product.

3.3.2 Tesco Own Brand – Strawberry Yogurt Products

The Tesco own brand yogurt products selected for analysis are outlined in Table 3.20, including the price per product and per kg of product.

Value Tier	No product Comparable	N/A
Core Tier	Tesco Senga Strawberry Yoghurt 150g	€0.75 or €5.00/kg
Premium Tier	Tesco Finest Senga Strawberry Heritage Raspberry 150G	€1.15 or €7.67/kg

Table 3.20 The products selected from Tesco’s three own brand tiers for tier three of the food pyramid (adapted from Tesco, 2024).

The nutritional value of these products is as set out in Table 3.21, detailing the macro nutrient content, overall energy contribution, as well as the calcium and salt level.

	Tesco Core		Tesco Premium	
	Per 100g	% RI	Per 100g	% RI
Energy	597kJ	7%	522kJ	6%
	143kcal	7.15%	125kcal	6.25%
Fat	7.7g	11%	5.8g	8.3%
Of which saturates	5.1g	25.5%	2.8g	14%
Carbohydrate	14.6g	5.6%	14.5g	5.6%
of which sugars	14.3g	15.8%	11.7g	13%
Fibre	0.7g	2.33%	1g	3.3%
Protein	3.4g	6.8%	3.1g	6.2%
Salt	0.14g	2.3%	0.08g	1.3%
Calcium	N/A	N/A	N/A	N/A

Table 3.21 The nutritional contents of Tesco own brand strawberry yogurt products, across the core and premium tiers. (adapted from Tesco, 2024).

The value tier offering of strawberry yogurt in Tesco is a fat free Greek style strawberry yogurt. This product is not comparable and will cause the results to be skewed. Therefore, no product was analysed from Tesco in this category for the value tier.

The Tesco core tier offering of strawberry yoghurt and the Tesco premium tier offering of strawberry yoghurt have very similar energy levels. The core product is slightly higher in calories than the premium product, but this is only attributing to 1% of the recommended intake. However, the core product is higher in fats and saturated fats than the premium product. The ratio of saturated fats to fats is also higher in the core product. The core and premium products are almost equal in carbohydrates, with the core product 0.1g higher in carbohydrates than the premium product. The core product is higher in sugar than the premium product. Again, fibre in both products is similar, with the premium product 0.3g higher in fibre than the core product. The salt in the core product is higher than the premium but both products are low in salt. Neither the core product nor the premium product outlined the calcium value in the yoghurt.

Tesco Own Brand Strawberry Yogurt Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	No product suitable for analysis	Milk Strawberry (17%) Whipping Cream (12%) Sugar Water Milk Proteins Modified Maize Starch Preservative: Potassium Sorbate Concentrated Lemon Juice Flavouring Acidity Regulator: Sodium Citrate Concentrated Elderberry Juice Lactic Starter Culture	Milk Cream (8%) Sugar Raspberry (7%) Strawberry (5%) Water Dried Skimmed Milk Cornflour Live Cultures Flavouring Concentrated Lemon Juice Colour: Anthocyanins
Claims on Pack	No product suitable for analysis	100% Irish whipping cream Produced in Ireland and made using Irish milk and cream and non-EU strawberries	Made with Irish Cream and Milk in Co. Wexford

Table 3.22 The ingredient declarations and nutritional claims of Tesco’s own brand strawberry yogurt products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Tesco, 2024).

In terms of ingredients, the core product has more ingredients than the premium product. The main ingredient in both products is milk as expected. However, the core product has a higher amount of fruit than the premium product, which could account for the higher sugar value in the core product. The premium product has two types of fruit, with strawberries and raspberries. Surprisingly, the raspberries are higher in quantities in this product. The core product does not contain live cultures while the premium product does. The core product also contains food additives such as preservatives, flavouring and acidity regulators. However, the premium product also contains colourings and flavourings. Overall, the premium product is lower in sugars, and saturated fats and has the cleaner label. It would be recommended as this is the more beneficial product.

3.3.3 SuperValu Own Brand – Strawberry Yogurt Products

The SuperValu own brand yogurt products selected for analysis are outlined in Table 3.23, including the price per product and per kg of product.

Value Tier	No product comparable	N/A
Core Tier	SuperValu Organic Strawberry Yogurt 450g	€1.29 or €2.87/kg
Premium Tier	SuperValu Signature Tastes Strawberry Yogurt 140g	€1.19 or €8.50/kg

Table 3.23 The products selected from SuperValu’s three own brand tiers for tier three of the food pyramid (adapted from SuperValu, 2024).

The nutritional value of these products is as set out in Table 3.24, detailing the macro nutrient content, overall energy contribution, as well as the calcium and salt level.

	SuperValu Core		SuperValu Premium	
	Per 100g	% RI	Per 100g	% RI
Energy	309kJ	3.68%	488kJ	5.8%
	74kcal	3.7%	117kcal	5.85%
Fat	3.3g	4.71%	6g	8.6%
Of which saturates	2g	10%	3.7g	18.5%
Carbohydrate	8g	3.1%	12g	4.6%
of which sugars	6.9g	7.67%	12g	13.3%
Fibre	0.5g	1.67%	0.5g	1.67%
Protein	3g	6%	3.4g	6.8%
Salt	0.08g	1.3%	0.13g	2.2%
Calcium	101mg	13.47%	N/A	N/A

Table 3.24 The nutritional contents of SuperValu own brand strawberry yogurt products, across the core and premium tiers. (adapted from SuperValu, 2024).

The SuperValu premium strawberry yogurt is higher in energy content than the core offering by 2.15% of the recommended intake. The premium product is higher in all nutrients than the core product with the exception of fibre and calcium. The core and premium products are equal in the fibre content of 0.5g per 100g of product. The core product has a calcium value of 101mg per 100g, while the premium product does not declare the calcium value. The premium product in compared to the core product is high in sugar, with almost double the quantity per 100g. The protein and salt content of both products is relatively low.

SuperValu Own Brand Strawberry Yogurt Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	No product suitable for analysis	Organic Whole Milk Organic Strawberries (8%) Water Organic Cane Sugar Organic Tapioca Starch Natural Strawberry Flavouring Organic Lemon Juice Concentrate Thickener: Pectin Yogurt Cultures: Lactobacillus Casei, Streptococcus Thermophilus Organic Aronia Juice Concentrate.	Milk Fruit Compote (20%) (Strawberries, Sugar, Gelling Agent: Pectin, Elderberry Concentrate) Cream (8%) Sugar Skimmed Milk Powder Live Cultures
Claims on Pack	No product suitable for analysis	Gluten free Organic Suitable for Vegetarians	Handmade in Co. Wexford Gluten free

Table 3.25 The ingredient declarations and nutritional claims of SuperValu’s own brand strawberry yogurt products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from SuperValu, 2024).

In terms of ingredients, the core product is produced using organic raw materials. This product is also made using strawberries while the premium product is made using a strawberry compote which adds sugar and pectin into the product. Both products contain live yogurt cultures which is beneficial for the gut microbiome. While the premium product

has less ingredients, the core product based on the nutritional quantity including the calcium content and organic ingredients could be considered the more beneficial product here.

3.3.4 Branded Product – Strawberry Yogurt Product

Glenilen Farm Live Natural Yoghurt with Strawberries 4 x 125g is the branded product most comparable to the own-brand products whose nutritional data was analysed above. It is currently sold for €2.99 or €5.98/kg. The nutritional value of this product is as set out in Table 3.26. No fibre or calcium value was provided.

	Per 100g	% RI
Energy	355kJ	4.23%
	84kcal	4.2%
Fat	2.8g	4%
of which saturates	1.8g	9%
Carbohydrate	11.4g	4.38%
of which sugars	10.9g	12.11%
Fibre	N/A	N/A
Protein	3.7g	7.4%
Salt	0.15g	6.52%
Calcium	N/A	N/A

Table 3.26 The nutritional contents of Glenilen Farm Live Natural Yoghurt with Strawberries 4 x 125g (adapted from Dunnes Stores, 2024).

The branded product selected from this shelf of the food pyramid is relatively low in calories, with only 4.2% of the recommended intake per 100g of product. Again, fat and saturated fats are also low in this product. The fat in this product contributes to 25.2kcal out of the 84kcal total energy value. The carbohydrates, particularly the sugars are high in this product, with 12.11% of the recommended intake of sugars per 100g of this product. The protein in this product accounts for 14.8kcal of the total energy content of the product. No calcium value of this product is not available in the public domain.

Branded Strawberry Yogurt Product	
Brand	Glenilen Farm Live Natural Yoghurt with Strawberries 4 x 125g
Ingredients	Natural Yoghurt (Pasteurised Whole Milk, Water, Skimmed Milk Powder, Live Yoghurt Cultures) Strawberries (17.2%), Sugar (4.3%) Cornflour (0.5%)
Claims on Pack	Made with a few simple ingredients and 5 live cultures Gluten free

Table 3.27 The ingredient declarations and nutritional claims of Glenilen Farm Live Natural Yoghurt with Strawberries 4 x 125g. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Dunnes Stores, 2024).

Milk, as with all the retailers own brand product is the main ingredient in this product. The declaration of this product has the breakdown of the natural yogurt separate to the strawberry flavour of the product. However, the strawberries are quidded at over 17% of the product, which could be attributing to the high sugar content. The natural fructose in strawberries, as well as the 4.3% of added sugar in this product explains why the carbohydrates are contributing 11.52kcal of the overall energy of the product. This is a very natural product with no food additives incorporated and live yogurt cultures which is beneficial for the microbiome.

3.3.5 Overall Analysis of Retail Own Brand Strawberry Yogurt Products

Strawberry Yogurt Core Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	445kJ	597kJ	309kJ	450kJ
Energy kcal	106kcal	143kcal	74kcal	108kcal
Fat	2.8g	7.7g	3.3g	4.6g
of which saturates	2g	5.1g	2g	3.03g
Carbohydrate	15g	14.6g	8g	12.53g
of which sugars	15g	14.3g	6.9g	12.07g
Fibre	0.9g	0.7g	0.5g	0.7g
Protein	4.4g	3.4g	3g	3.6g
Salt	0.14g	0.14g	0.08g	0.12g
Calcium	148mg	N/A	101mg	124.5mg
Cost € per KG	€3.98	€5.00	€2.87	€3.95
Cost € per 100g	€0.40	€0.50	€0.29	€0.40

Table 3.28 The nutritional value of all own brand strawberry yogurt products analysed from the core tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre, calcium and salt level of all.

On analysing the overall core tier group of strawberry yogurt from all three retailers, the Tesco product was highest in energy, followed by Dunnes Stores, with SuperValu having the least overall calorific value for this core tier. The Tesco core product was also the highest in fat, with a total contribution to the energy of 30.8kcal, while the SuperValu core product had a contribution of 13.2kcal of the energy from fat in the product and the product from Dunnes Stores had a 11.2kcal contribution of energy from fat. The Tesco product was also the highest in saturated fats at 5.1g per 100g of product, while Dunnes Stores and SuperValu add an equal amount of saturated fats at 2g per 100g a product. The Dunnes Stores strawberry yoghurt from the core tier had the highest amount of carbohydrates however this was only 0.4g more than the Tesco product. The SuperValu core yoghurt at almost half the amount of carbohydrates than the Dunnes Stores product. The Dunnes Stores strawberry yoghurt was also the highest in sugar content at 15g per 100g of product. However, again this was only 0.7g more than the sugar content of the Tesco product. The SuperValu product was

relatively low in sugar compared to the other two products. The overall fibre quantities in the three retailers own brand product were low. The Dunnes Stores yoghurt had the highest quantity of protein, with 1g more protein per 100g of product. While the Tesco and SuperValu products were similar in protein quantity. The SuperValu product was lowest in salt, however salt values across all three retailers in this product was low. Lastly, the calcium quantity was not public domain information for the Tesco core product, however the Dunnes Stores strawberry yoghurt was higher in calcium than the SuperValu product. The most expensive product was the Tesco product at €0.50 per 100g of product, while the SuperValu product was the cheapest product at €0.29 per 100g. The most nutritionally beneficial product from the three retailer in terms of strawberry yogurts from the core offering, was the SuperValu product due to the low saturated fat and sugar value.

Strawberry Yogurt Premium Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	586kJ	522kJ	488kJ	532KJ
Energy kcal	140kcal	125kcal	117kcal	127kcal
Fat	7.1g	5.8g	6g	6.3g
of which saturates	4.9g	2.8g	3.7g	3.8g
Carbohydrate	16g	14.5g	12g	14.17g
of which sugars	14g	11.7g	12g	12.57g
Fibre	0.8g	1g	0.5g	0.77g
Protein	2.8g	3.1g	3.4g	3.1g
Salt	0.08g	0.08g	0.13g	0.1g
Calcium	N/A	N/A	N/A	N/A
Cost € per KG	€5.98	€7.67	€8.50	€7.38
Cost € per 100g	€0.60	€0.77	€0.85	€0.74

Table 3.29 The nutritional value of all own brand strawberry yogurt products analysed from the premium tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre, calcium and salt level of all.

The Dunnes Stores strawberry yogurt was the product with the highest energy value across the three retailers from the premium tier at 140kcal per 100g. This was followed by the

Tesco premium yogurt at 125kcal. The SuperValu product was slightly lower in energy than the Tesco product by only 8kcal. The Dunnes Stores product was also higher in fat and saturated fats. The overall fat contribution of fat to the energy value of the Dunnes Stores product was 63.9kcal. The SuperValu product had the second highest fat values with a 54kcal contribution to the energy value. Tesco's premium strawberry yogurt was the lowest in fat with an energy contribution of 52kcal. Again, the Dunnes Stores premium product was highest in carbohydrates at 16g, 1.5g more per 100g of product than the Tesco product and 4g per 100g more than the SuperValu product. However, the ratio of carbohydrates to sugar was greater in the SuperValu product, compared to the Dunnes Stores and Tesco products. The fibre values across these products were overall small, but the Tesco product had the highest quantity of fibre with 1g per 100g of product. The Dunnes Stores premium product was the lowest in protein, while the SuperValu product was higher in protein with an energy contribution of 13.6kcal. The SuperValu product was highest in salt, while the Tesco and Dunnes Stores product had equal salt values per 100g of yogurt. However, salt values were low across the three retailers for this product category. Finally, no calcium value was declared for this tier.

Strawberry Yogurt Own Brand vs Branded			
Nutrient	Core Tier Mean	Premium Tier Mean	Branded
Energy kJ	450 kJ	532 kJ	355 kJ
Energy kcal	108kcal	127kcal	84kcal
Fat	4.6g	6.3g	2.8g
of which saturates	3.03g	3.8g	1.8g
Carbohydrate	12.53g	14.17g	11.4g
of which sugars	12.07g	12.57g	10.9g
Fibre	0.7g	0.77g	N/A
Protein	3.6g	3.1g	3.7g
Salt	0.12g	0.1g	0.15g
Calcium	124.5mg	N/A	N/A
Cost € per KG	€3.95	€7.38	€5.98
Cost € per 100g	€0.40	€0.74	€0.60

Table 3.30 The nutritional value of all own brand strawberry yogurt products analysed from the value, core and premium tiers in comparison to a selected branded product. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre, calcium and salt level of all.

In comparing the mean value of the core tier own brand strawberry yogurts to the mean premium tier own brand strawberry yogurt products, the core mean energy is lower than the premium tier mean. The premium products had a higher fat quantity overall than the core tier, however, both tiers were similar in saturated fats. The premium tier had the highest amount of carbohydrates, but again they were very similar in sugar quantities. The overall fibre quantities only differed by 0.07g and the core tier had an average of 0.4g more protein per 100g of yogurt than the premium products. Likewise with the salt quantity of the core tier was only 0.02g more than the premium tier per 100g, a very negligible difference. Lastly, the core tier was the only tier with given calcium quantities, The calcium quantities in the premium products was not public domain information. In comparing the branded product to the core and premium mean values, the branded product was lower in every nutrient with the exception of protein, which was 0.1g more than the core tier per 100g of yogurt. The branded product was lower in sugar than the own brand products, and it was also lower in saturated fats, with 2g less saturated fats per 100g of product than the premium own brand products, and 1.23g per 100g less than the core tier. The most expensive products

were the premium own brand strawberry yogurts, while the core tier own brand products were the least expensive.

In terms of statistical significance, each energy value, macronutrients and micronutrients were analysed between each of the tiers using the mean value calculated across the three retailers. In terms of energy (KJ), the p value calculated between the mean own brand core and premium tiers was $p= 0.41$. This result means the data is not statistically significant. Additionally, while there is some correlation between the price and the energy content of the strawberry yogurt own brand products, as illustrated in Figure 3.9 below, it varies greatly between retailers.

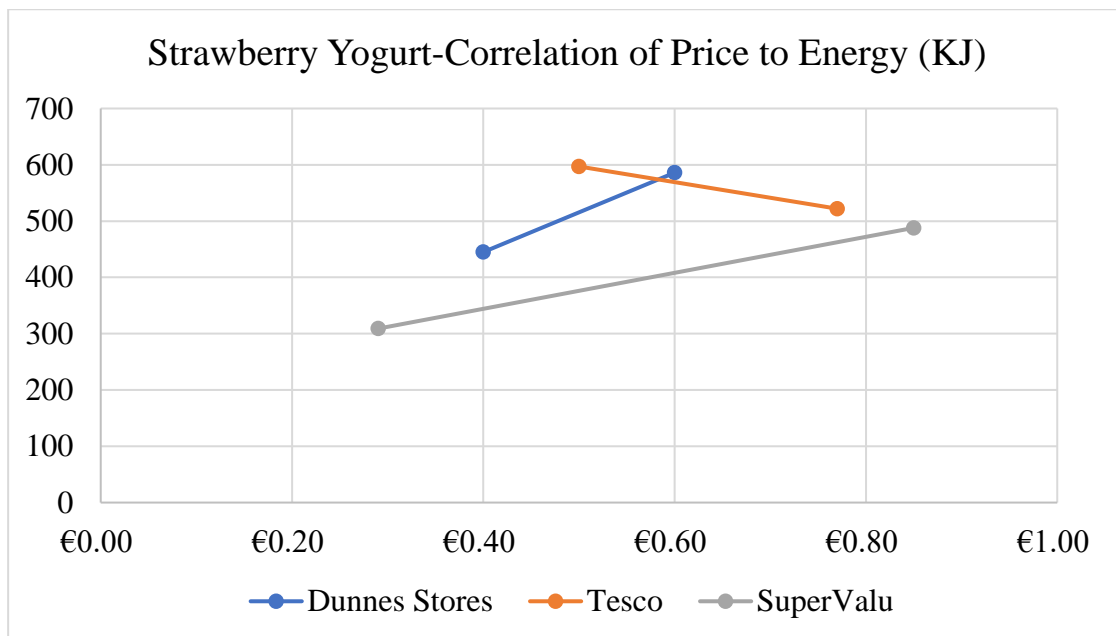


Figure 3.9 The correlation of the energy content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a positive correlation, with the energy increasing with price. Tesco has a negative correlation with the energy value reducing as the price increases. SuperValu has a steep increase in price between the two ranges, but the energy value also increases with price, giving a positive correlation. However, as there are only two data points for this product, it cannot be said with certainty that this correlation is reliable.

In terms of fat per 100g of product, the p value calculated between the mean own brand core and premium tiers was $p= 0.35$. This result means the data is not statistically significant. There is a correlation between the price and the fat content of the strawberry yogurt own brand products, as visible in Figure 3.10 below, but it varies greatly between retailers.

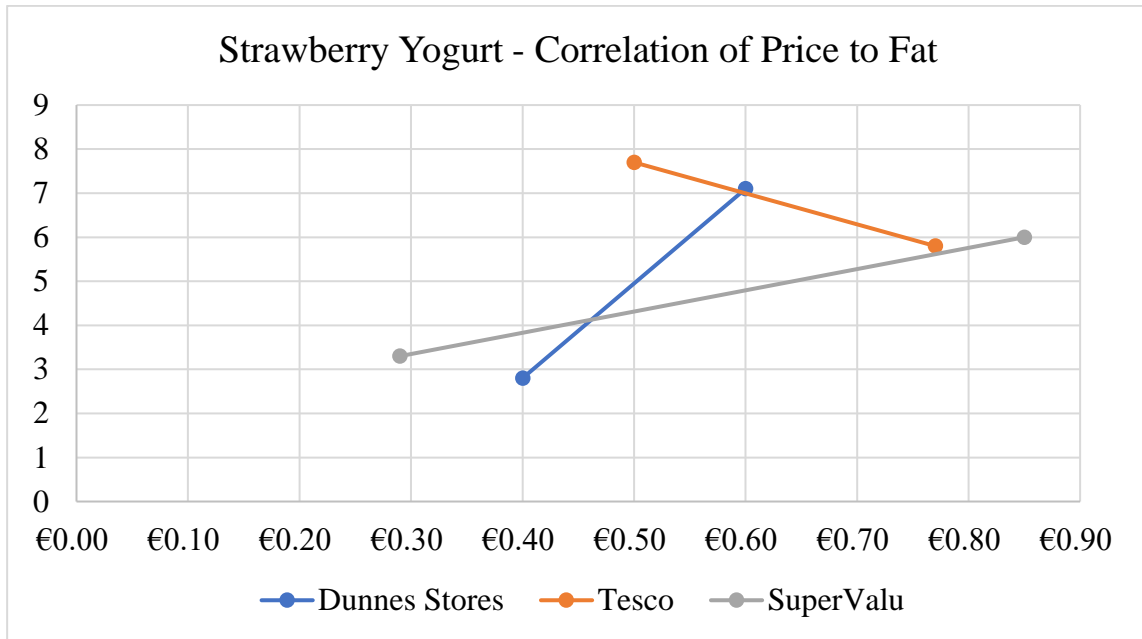


Figure 3.10 The correlation of the fat content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a positive correlation, with the fat quantity increasing with price. Tesco has a negative correlation with the fat content reducing as the price increases. SuperValu has a steep increase in price between the two ranges, but the fat content of the product increases with price, giving a positive correlation. However, as there are only two data points for these product, it cannot be said with certainty that this is a reliable correlation.

The p value calculated between the mean own brand core and premium tiers in terms of saturated fats was $p= 0.56$. This result means the data is not statistically significant. There is a correlation between the price and the saturated fat content of the strawberry yogurt own brand products, as illustrated in Figure 3.11 below, it varies greatly between retailers.

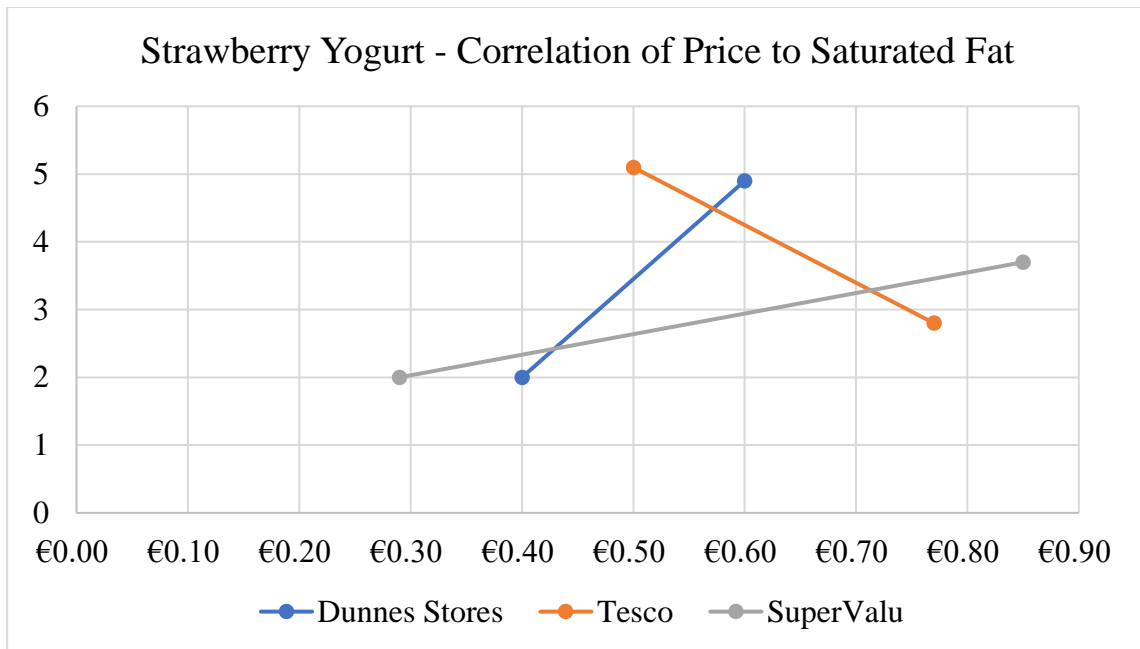


Figure 3.11 The correlation of the saturated fat content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a positive correlation, with the saturated fat quantity increasing with price. Tesco has a negative correlation with the saturated fat content reducing as the price increases. SuperValu has a positive correlation, with the saturated fat quantity increasing with price. However, as there are only two data points for these product, it cannot be said with certainty that this is a reliable correlation. This correlation is visibly very similar to the correlation of fat content to saturated fat content.

In terms of carbohydrates per 100g of product, the p value calculated between the mean own brand core and premium tiers was $p=0.55$. This result means the data is not statistically significant. There is a correlation between the price and the carbohydrate content of the strawberry yogurt own brand products, as outlined in Figure 3.12 below, but it varies greatly between retailers.

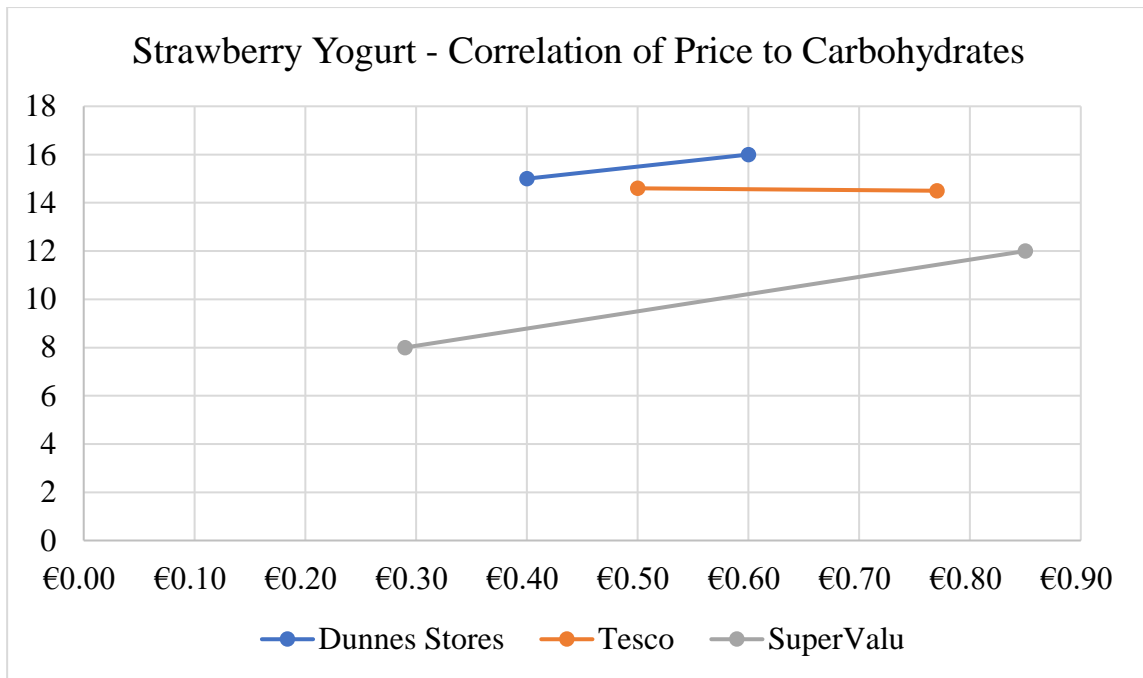


Figure 3.12 The correlation of the carbohydrate content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a very slight positive correlation, with the carbohydrate quantity increasing with price. Tesco has an almost negligible negative correlation with the carbohydrate content reducing very slightly as the price increases. SuperValu has a steep increase in price between the two ranges, but the carbohydrate content of the product also increases with price, giving a positive correlation. However, as there are only two data points for these product, it cannot be said with certainty that this is a reliable correlation.

The p value calculated between the mean own brand core and premium tiers in terms of sugars was $p= 0.86$. This result means the data is not statistically significant. There is a correlation between the price and the sugar content of the strawberry yogurt own brand products, as visible in Figure 3.13 below, but it varies greatly between retailers.

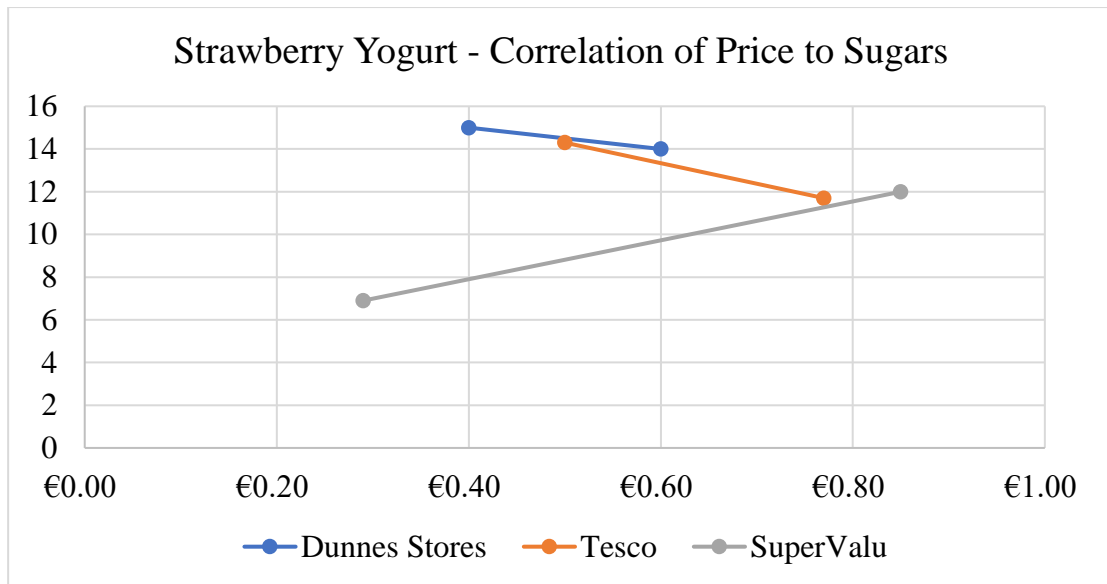


Figure 3.13 The correlation of the sugar content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a negative correlation, with the sugar quantity decreasing with price. Tesco also has a negative correlation with the sugar quantity reducing as the price increases. SuperValu, however, has a positive correlation, with the sugar quantity increasing with price. However, as there are only two data points for these product, it cannot be said with certainty that this is a reliable correlation.

In terms of fibre per 100g of product, the p value calculated between the mean own brand core and premium tiers was $p=0.73$. This result means the data is not statistically significant. There is a correlation between the price and the fibre content of the strawberry yogurt own brand products, as outlined in Figure 3.14 below, but it also varies greatly between retailers.

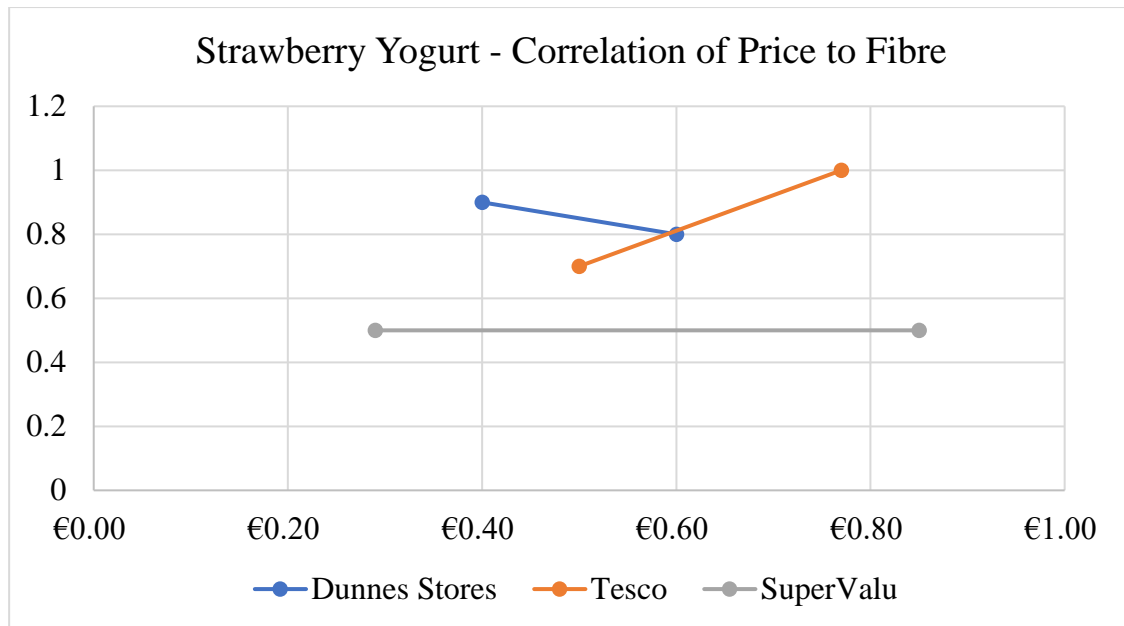


Figure 3.14 The correlation of the fibre content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a negative correlation, with the fibre quantity decreasing as the price increases. Tesco has a steep positive correlation with the fibre value increasing as the price increases. SuperValu has no correlation, the fibre value to not change as the price increases or decreases. As there are only two data points for these product, it cannot be said with certainty that this is a reliable correlation.

The p value calculated between the mean own brand core and premium tiers in terms of protein was $p = 0.32$. This result means the data is not statistically significant. There is a correlation between the price and the protein content of the strawberry yogurt own brand products, as illustrated in Figure 3.15 below, but it varies between retailers.

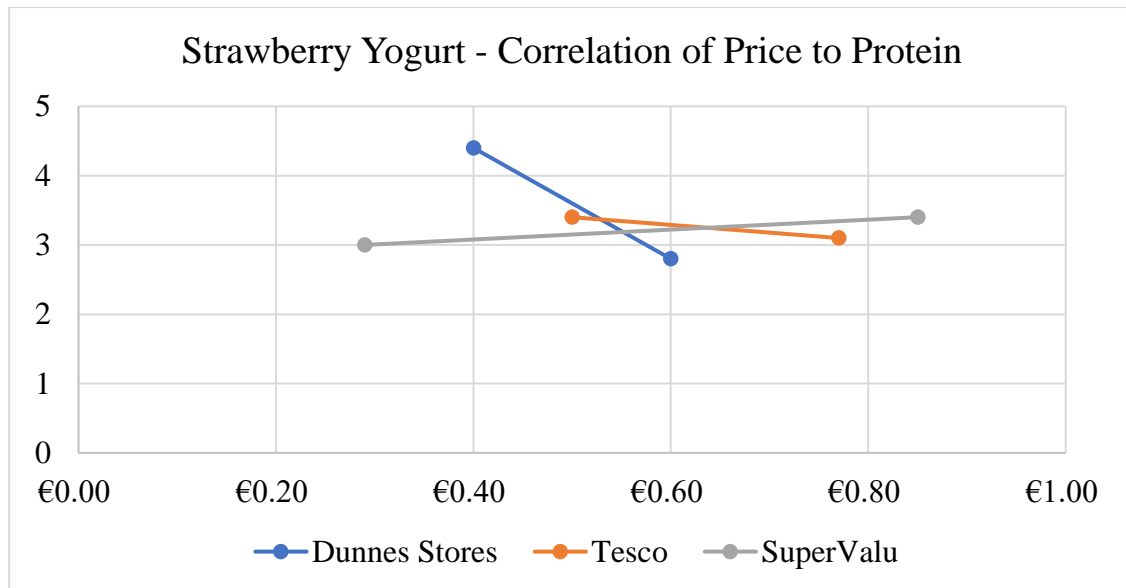


Figure 3.15 The correlation of the protein content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores has a steep negative correlation, with the protein content decreasing with price. Tesco has a slight negative correlation with the protein quantity decreasing slightly as the price increases. SuperValu has a slight positive correlation; the protein quantity increases as the price increases. However, as there are only two data points for these products, it cannot be said with certainty that this is a reliable correlation.

In terms of salt per 100g of product, the p value calculated between the mean own brand core and premium tiers was $p=0.42$. This result means the data is not statistically significant. There is a correlation between the price and the salt content of the strawberry yogurt own brand products, as outlined in Figure 3.16 below, but it also varies greatly between retailers.

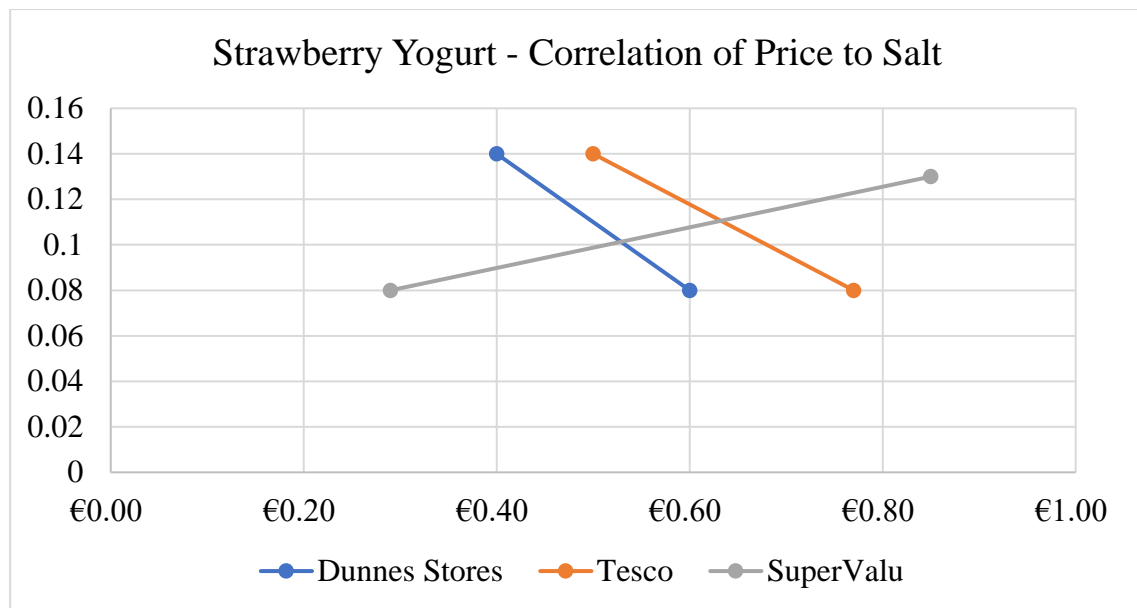


Figure 3.16 The correlation of the salt content and price of Dunnes Stores, Tesco and SuperValu own brand strawberry yogurt products across each tier.

Dunnes Stores and Tesco both have a negative correlation, with the salt quantity decreasing as the price increases. SuperValu then has a positive correlation with the salt content increasing as the price increases. As there are only two data points for these product, it cannot be said with certainty that this is a reliable correlation.

As only the core products had the calcium quantity available as public domain knowledge, the statistical significance cannot be calculated for this micronutrient.

3.4 Shelf Four - Food Pyramid

Tier four of the food pyramid describes an array of meat, poultry, fish, eggs, beans and nuts. For the purpose of this thesis, a product will not be analysed from this tier as given the nature of these products, the basic nutritional value of each product will be calculated based on the same database such as Nutricalc and is not relevant to the topic of this thesis.

3.5 Shelf Five - Food Pyramid

The fifth tier of the food pyramid outlines fats, spreads and oils. All three retailers; Dunnes Stores, Tesco and Super Value offer only one or two tiers of these products due to the basic nature. Therefore, no product will be analysed from this tier of the food pyramid.

3.6 Top Shelf - Food Pyramid

The top shelf of the food pyramid outlines the products that should not be eaten in excess. This includes chocolate, fizzy drinks and snacks such as crisps and biscuits. The product that will be analysed in this tier is chocolate cookies. The confectionary category was valued at €601 million for the year 21st May 2022 to 2023 (Ahern, 2023). Cookies were chosen for this analysis as they are a generic confectionary product with a large sale group. According to Prudent Markets, the Global cookie market is expected to reach approximately \$41.2 billion by 2026, an expected increase of 5.23% from 2024 (Prudent Markets, 2024).

3.6.1 Dunnes Stores Own Brand – Chocolate Cookies

Table 3.31 outlines the three products selected across the three tiers, including the price per product and per Kg of product.

Value Tier	Dunnes Stores Chocolate Chip Cookies 200g	€0.79 or €3.95/kg
Core Tier	Dunnes Stores Chocolate Chunk Cookies 225g	€1.39 or €6.18/kg
Premium Tier	Dunnes Stores Simply Better Handmade Belgian Triple Chocolate Cookies 185g	€2.69 or €14.54/kg

Table 3.31 The products selected from Dunnes Stores three own brand tiers for the top tier of the food pyramid (adapted from Dunnes Stores, 2024).

The nutritional value of these products is as set out in Table 3.32, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	Dunnes Stores Value		Dunnes Stores Core		Dunnes Stores Premium	
	Per 100g	% RI	Per 100g	% RI	Per 100g	% RI
Energy	1989kJ	22.6%	2100kJ	25%	1900kJ	22.62%
	475kcal	24%	502kcal	25.1%	454kcal	22.7%
Fat	22g	31.43%	26g	37.14%	22g	31.43%
of which saturates	11g	55%	14g	70%	13g	65%
Carbohydrate	62g	23.85%	58g	22.31%	58g	22.31%
of which sugars	32g	35.56%	32g	35.56%	32g	35.56%
Fibre	4.5g	15%	4.1g	13.67%	2g	6.67%
Protein	6.3g	12.6%	7g	14%	5.5g	11%
Salt	0.45g	7.5%	0.9g	15%	0.37g	6.2%

Table 3.32 The nutritional contents of Dunnes Stores own brand chocolate cookie products, across the three tiers, budget, core and premium. (adapted from Dunnes Stores, 2024).

The Dunnes Stores core chocolate cookie product is highest in energy compared to the budget and premium product. The core cookies per 100g are over 25% of the recommended intake of energy daily, while the premium cookies have the lowest energy content, with 22.7% of the recommended intake of energy daily. The Dunnes Stores core cookies are also the highest in fat, contributing to 234kcal out of the 502kcal in the product. The value to your cookies and the premium tier cookies has the same quantity of fat per 100g. However, the premium product has a higher saturated fat value by 2g. The Dunnes Stores core cookies have the highest saturated fat value at 14g, which accounts for 70% of the recommended intake of saturated fats daily per 100g of the product. Dunnes Stores value tier cookies are highest in carbohydrates, while the core and premium tier have the same quantity of carbohydrates per 100g of product. Each three products, across all three tiers, have the same sugar value. Overall, the sugar value of these products is fairly high. The fibre value of the value product is slightly higher than the premium product by 0.4g. While the premium

product has the lowest amount of fibre at only 2g. The core product has the highest amount of protein; however, this is only by 0.7g compared to the value tier. Dunnes Stores premium cookies has the lowest amount of protein at 5.5g per 100g. Lastly, the salt value in the core tier is higher than the other two tiers. It is almost double the recommended intake value of the other two tiers. Overall, based on the nutritional information, it could be recommended that the Dunnes Stores premium cookie product is more beneficial and the core product is least beneficial.

Dunnes Stores Own Brand Chocolate Cookie Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	Fortified Wheat Flour Chocolate Chips (22%) [Sugar, Cocoa Mass, Dextrose, Cocoa Butter, Emulsifier: Sunflower Lecithin's] Sugar Palm Oil Whey Powder Golden Syrup Raising Agents: Sodium Bicarbonate, Disodium Diphosphate, Ammonium Bicarbonate Emulsifier: Soya Lecithin Natural Vanilla Flavouring	Wheat Flour Dark Chocolate (29%) [Cocoa Mass, Sugar, Emulsifier: Sunflower Lecithin], Palm Fat Milk Chocolate (11%) [Sugar, Cocoa Mass, Skimmed Milk Powder, Cocoa Butter, Butter Oil, Emulsifier: Sunflower Lecithin] Sugar Glucose Syrup Whole Egg Raising Agents: Disodium Diphosphate, Sodium Bicarbonate Glucose-Fructose Syrup Wheat Starch Caramel Sugar Syrup Salt Whole Milk Powder Natural Flavouring Egg White Powder	Wheat Flour Muscovado Sugar Unsalted Irish Butter (18%) Irish Oats Belgian White Chocolate Chunks (10%) [Sugar, Whole Milk Powder, Cocoa Butter, Skimmed Milk Powder, Emulsifier: Soya Lecithin; Natural Vanilla Flavouring] Belgian Milk Chocolate Chunks (7%) [Sugar, Whole Milk Powder, Cocoa Butter, Cocoa Mass, Whey Powder (Milk), Emulsifier: Soya Lecithin; Natural Vanilla Flavouring] Belgian Dark Chocolate Chunks (5%) [Cocoa Mass, Sugar, Emulsifier: Soya Lecithin; Vanilla Extract] Water Orange Blossom Honey (1.5%).
Claims on Pack	Suitable for Vegetarians	There are no claims on pack.	Free from Hydrogenated Fat

Table 3.33 The ingredient declarations and nutritional claims of Dunnes Stores own brand chocolate cookie products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Dunnes Stores, 2024).

Compared to the other products analysed as part of this research, the cookie products have larger ingredient declaration. Looking at the variation between the Dunnes Stores value, core and premium tiers, the value tier cookies are the only product with fortified wheat flour. However, it is also the most processed product in terms of food additives. The core tier has both dark and milk chocolate present in the product compared to the value product that just

has milk chocolate. This product also has used food additives such as emulsifiers and raising agents, As well as glucose-fructose syrup. The premium tier cookies have a more recognisable ingredient declaration. It could be compared to a chocolate chip cookie recipe from a cookbook. The muscovado sugar, unsalted butter and oats can all be attributed to a typical cookie recipe. This product also contains white, milk and dark chocolate. Based on the ingredient declaration, the Dunnes Stores premium product would be recommended as most beneficial due to the clean ingredient declaration, with the core product being the least recommended due to the lack of fortified flour and the use of food additives.

3.6.2 Tesco Own Brand – Chocolate Cookies

The current Tesco own brand chocolate cookie products selected for analysis are outlined in Table 3.34, including the price per product and per kg of product.

Value Tier	Tesco Chocolate Chip Cookies 250g	€1.10 or €4.40/kg
Core Tier	Tesco Chunky Chocolate 10 Cookies 200g	€1.95 or €9.75/kg
Premium Tier	Tesco Finest Quadruple Chocolate Cookies 200g	€2.20 or €11.00/kg

Table 3.34 The products selected from Tesco’s three own brand tiers for the top shelf of the food pyramid (adapted from Tesco, 2024).

The nutritional value of these products is as set out in Table 3.35, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	Tesco Value		Tesco Core		Tesco Premium	
	Per 100g	% RI	Per 100g	% RI	Per 100g	% RI
Energy	2052kJ	24.4%	2098kJ	25%	2141kJ	25.5%
	490kcal	24.5%	502kcal	25%	512kcal	25.6%
Fat	23.7g	33.86%	25.9g	37%	27.5g	39.3%
of which saturates	12.1g	60.5%	13.6g	68%	16.4g	82%
Carbohydrate	62.1g	23.9%	59.6g	22.9%	58.3g	22.4%
of which sugars	27.5g	30.6%	32.5g	36%	34g	37.8%
Fibre	2.7g	9%	3.6g	12%	3g	10%
Protein	5.7g	11.4%	5.8g	11.6%	6.3g	12.6%
Salt	0.5g	8.3%	0.58g	9.7%	0.43g	7.2%

Table 3.35 The nutritional contents of Tesco own brand chocolate cookie products, across the three tiers, budget, core and premium. (adapted from Tesco, 2024).

The Tesco premium cookie product is the highest in energy content, with 25.6% of the recommended intake of energy per 100g of product. However, the budget and core cookie products in Tesco are of similar energy values. The budget cookies account for 24.5% of the recommended intake of energy per 100g of product and the core cookies account for 25%. The premium tier is also highest in fat with 27.5g of fat per 100g. This is closely followed by the core tier at 25.9g, with the budget tier having the lowest fat value at 23.7g. The premium tier cookies at Tesco also have the highest saturated fat content at 16.4g, or 82% of the recommended saturated fat intake per day in 100g of product. The core cookie product has the second highest level of saturated fats at 13.6g or 68% RI. The budget tier cookies at Tesco have the lowest value of saturated fats at 12.1g or 60.5% RI. The Tesco budget cookies are highest in carbohydrates at 62.1g while the premium cookies have the lowest carbohydrate levels at 58.3g. However, the sugars are the inverse of this, with the premium tier containing the highest amount of sugars at 34g, while the budget tier has the

lowest content of sugar at 27.5g. The core tier cookies have the highest fibre value, with 12% RI, followed by the premium product at 10% RI. In terms of protein, the premium tier has the highest content of protein, with 0.5g more protein per 100g of product than the core tier cookies. The core cookies have 0.1g more protein per 100g of product than the budget tier. Finally, the Tesco core tier has the highest salt level, however this is only 0.08g more than the budget tier. Based on the nutritive value of each product, it could be recommended that the budget product is less problematic to the diet as this product contains lower saturated fats, sugar and salt values in particular comparison to the premium product.

Tesco Own Brand Cookie Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	Fortified Wheat Flour Dark Chocolate Chips (22%) [Sugar, Cocoa Mass, Palm Oil, Sal Fat, Shea Fat, Emulsifiers: Soya Lecithin's, Ammonium Phosphatides, Polyglycerol Polyricinoleate, Cocoa Butter, Flavouring] Palm Oil Sugar Whey Powder Partially Inverted Sugar Syrup Raising Agents: Sodium Bicarbonate, Ammonium Bicarbonate Salt Flavouring	Fortified Wheat Flour Dark Chocolate Chunks (17%) [Sugar, Cocoa Mass, Cocoa Butter, Palm Fat, Sal Fat, Shea Fat, Mango Kernel Fat, Emulsifier: Soya Lecithin's] Milk Chocolate Chunks (17%) [Sugar, Cocoa Mass, Dried Whole Milk, Cocoa Butter, Whey Powder (Milk), Emulsifier: Soya Lecithin's, Palm Fat, Sal Fat, Shea Fat, Mango Kernel Fat] Palm Oil Sugar Oatmeal Invert Sugar Syrup Desiccated Coconut Glucose Syrup Raising Agents (Ammonium Bicarbonate, Sodium Bicarbonate, Disodium Diphosphate) Molasses Salt Emulsifier: Soya Lecithin's Flavouring	Fortified Wheat Flour Belgian Milk Chocolate (20%) [Sugar, Cocoa Butter, Dried Whole Milk, Cocoa Mass, Emulsifier: Soya Lecithin's, Flavouring] Butter (14%) Belgian Dark Chocolate Chunks (11%) [Sugar, Cocoa Mass, Cocoa Butter, Emulsifier (Soya Lecithin's), Flavouring] Belgian Milk Chocolate Chunks (10%) [Sugar, Dried Whole Milk, Cocoa Butter, Cocoa Mass, Emulsifier: Soya Lecithin's, Flavouring] Sugar Belgian White Chocolate Chunks (7%) [Sugar, Dried Whole Milk, Cocoa Butter, Dried Skimmed Milk, Emulsifier: Soya Lecithin's, Flavouring] Glucose Syrup Fat Reduced Cocoa Powder Raising Agents (Ammonium Hydrogen Carbonate, Sodium Bicarbonate) Salt Flavouring
Claims on Pack	There are no claims on pack.	There are no claims on pack.	There are no claims on pack.

Table 3.36 The ingredient declarations and nutritional claims of Tesco's own brand chocolate cookie products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Tesco, 2024).

All three Tesco cookie products contain fortified wheat flour. The value tier cookies contain dark chocolate only, while the core tier contains dark chocolate and milk chocolate. The premium tier is made with 20% milk chocolate, 11% dark chocolate and 7% white chocolate. The higher chocolate content of the premium cookies could be attributing to the higher sugar and fat values. The value tier product as the least amount of ingredients well the core and premium tier products have larger ingredient declarations. While the chocolate in each product contains emulsifiers, The value to your product has less food additives then the other two tiers.

3.6.3 SuperValu Own Brand – Chocolate Cookies

The SuperValu own brand chocolate cookie products selected for analysis are outlined in Table 3.37, including the price per product and per kg of product.

Value Tier	SuperValu Chocolate Chip Cookies 225g	€1.39 or €6.18/kg
Core Tier	SuperValu Fully Chocolate Coated Cookies 175g	€1.39 or €7.94/kg
Premium Tier	Signature Tastes All Butter Belgian Triple Chocolate Chunk Cookies 200g	€2.55 or €12.75/kg

Table 3.37 The products selected from SuperValu’s three own brand tiers for the top shelf of the food pyramid (adapted from SuperValu, 2024).

The nutritional value of these products is as set out in Table 3.38, detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	SuperValu Value		SuperValu Core		SuperValu Premium	
	Per 100g	% RI	Per 100g	% RI	Per 100g	% RI
Energy	2080kJ	24.8%	2216kJ	26.4%	2144kJ	25.5%
	497kcal	24.85%	530kcal	26.5%	513kcal	25.65%
Fat	25g	35.7%	29g	41.4%	27g	38.6%
of which saturates	13g	65%	17g	85%	17g	85%
Carbohydrate	61g	23.4%	60g	23%	61g	23.4%
of which sugars	37g	41%	44g	48.9%	39g	43.3%
Fibre	3.5g	11.67%	2g	6.67%	1.8g	6%
Protein	5.3g	10.6%	6.3g	12.6%	5.5g	11%
Salt	0.65g	10.83%	0.56g	9.3%	0.5g	8.3%

Table 3.38 The nutritional contents of SuperValu own brand chocolate chip cookie products, across the three tiers, budget, core and premium. (adapted from SuperValu, 2024).

The SuperValu core cookie product is the highest in energy content at 530kcal, or 26.5% RI. This is closely followed by the premium product which contains 513kcal or 25.65% RI. The budget SuperValu cookies are the lowest in energy content at 497kcal or 24.85% RI. The core tier cookies are also the highest in fat at 29g per 100g of product. The SuperValu premium cookies are 3g less than this at 27g, the budget cookies have the lowest fat content at 25g per 100g. The core and premium products have equal amounts of saturated fats at 17g. This accounts for 85% of the recommended intake daily of saturated fats per 100g of product. The SuperValu budget cookies are the lowest in saturated fats at 13g or 65% RI. The budget and premium cookies both have 61g of carbohydrates, while the core tier has 60g. The core product is highest in sugar, with 44g. The budget cookies have the lowest sugar quantity at 37g. The budgets cookies also have the highest fibre value with 3.5g of fibre per 100g of product. The premium cookies have the lowest fibre content at just 1.8g. Finally, the budget cookies have the higher salt value at 0.65g. However, this is only 0.1g

more than the core and premium cookies. Based on the nutritional information available, it could be suggested that the budget cookies are less problematic for the diet in comparison to the premium cookies, with the core tier cookies being the least beneficial for the consumer.

SuperValu Own Brand Chocolate Cookie Products			
Tier	Value Tier	Core Tier	Premium Tier
Ingredients	Dark Chocolate (29%) (Sugar, Cocoa Mass, Glucose Syrup, Cocoa Butter, Emulsifier: Soya Lecithin's) Wheat Flour Sugar Vegetable Oil (Palm Oil, Sunflower Oil) Milk Chocolate (11%) (Sugar, Cocoa Butter, Whole Milk Powder, Cocoa Mass, Skimmed Milk Powder, Emulsifier: Soya Lecithin's, Flavouring) Glucose-Fructose Syrup Butter Egg Skimmed Milk Powder, Wheat Starch Raising Agents: Diphosphates, Sodium Carbonates Colour: Plain Caramel Whole Milk Powder Egg White Powder Flavouring	Milk Chocolate Coating (35%) [Sugar, Cocoa Butter, Whole Milk Powder, Cocoa Mass, Emulsifier: Sunflower Lecithin] Wheat Flour Vegetable Oils (Palm, Sunflower) Sugar Dark Chocolate (5%) [Sugar, Cocoa Mass, Glucose Syrup, Cocoa Butter, Emulsifier: Sunflower Lecithin] Glucose-Fructose Syrup Raising Agents: Sodium Carbonates, Diphosphates Salt Flavouring	Fortified Wheat Flour Salted Butter (19%) Dark Chocolate Chunks (17%) [Sugar, Cocoa Mass, Cocoa Butter, Emulsifier: Soya Lecithin, Vanilla Flavouring] Sugar White Chocolate Chunks (9%) [Sugar, Whole Milk Powder, Cocoa Butter, Skimmed Milk Powder, Emulsifier: Soya Lecithin, Vanilla Flavouring] Milk Chocolate Chunks (8%) [Sugar, Whole Milk Powder, Cocoa Butter, Cocoa Mass, Emulsifier: Soya Lecithin, Vanilla Flavouring] Fat Reduced Cocoa Powder Golden Syrup Skimmed Milk Powder Raising Agents: Ammonium Bicarbonate, Sodium Bicarbonate
Claims on Pack	Suitable for vegetarians	Suitable for vegetarians	Suitable for vegetarians

Table 3.39 The ingredient declarations and nutritional claims of SuperValu’s own brand chocolate cookie products. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from SuperValu, 2024).

The SuperValu value tier cookies have the longest ingredient declaration. Dark chocolate is used in the highest quantities in this product, followed by wheat flour and sugar. There are many food additives in this product including flavourings colours and the use of glucose-fructose syrup. The SuperValu core tier cookies have milk chocolate as the highest quantity of ingredients used, followed by wheat flour, vegetable oils and sugar. The use of vegetable oils could attribute to the higher fat levels in this product. The core cookies have both milk chocolate and dark chocolate in the recipe. The premium tier cookies contain fortified wheat flour as the highest ingredient. This is followed by salted butter, dark chocolate, white chocolate and milk chocolate. The product uses fat reduced cocoa powder and does not contain glucose fructose syrup. Therefore, when considering both the ingredient declaration and the nutritional quantity of the products from the three tiers, it could be recommended that the premium product is the least harmful to the diet and the core product is the most problematic.

3.6.4 Branded Product – Chocolate Cookies

Maryland Choc Chip Cookies 200g is the branded product most comparable to the own-brand products whose nutritional data was analysed above. It is currently sold for €1.59 or €5.00/kg. The nutritional value of this product is as set out in Table 3.40 detailing the macro nutrient content, overall energy contribution, as well as the fibre and salt level.

	Per 100g	% RI*
Energy	2022kJ	24.07%
	483kcal	24.15%
Fat	22g	31.43%
of which saturates	11g	55%
Carbohydrate	65g	25%
of which sugars	31g	34.44%
Fibre	2.1g	7%
Protein	5.5g	11%
Salt	0.58g	9.7%

Table 3.40 The nutritional contents of Maryland Choc Chip Cookies 200g (adapted from Dunnes Stores, 2024).

The branded chocolate cookie product is high in calories, with 24.15% of the recommended intake of energy provided by 100g of product. The fat level as well as the saturated fats, as expected for a product of this nature, are also high. As are the carbohydrate and sugar quantities. The fibre, protein and salt content of the branded product is similar to those of the own brand labels as analysed above.

Branded Chocolate Cookie Product	
Brand	Maryland Choc Chip Cookies 200g
Ingredients	Fortified Wheat Flour Chocolate Chips (25%) (Sugar, Cocoa Mass, Vegetable Fats (Sustainable Palm, Shea, Sal), Emulsifiers: Soya Lecithin, Ammonium Phosphatides, Polyglycerol Polyricinoleate; Cocoa Butter, Flavourings) Sugar Palm Oil Whey or Whey Derivatives Partially Inverted Sugar Syrup Raising Agents: Sodium Bicarbonate, Ammonium Bicarbonate Salt Flavourings
Claims on Pack	Suitable for vegetarians

Table 3.41 The ingredient declarations and nutritional claims of Maryland Choc Chip Cookies 200g. Ingredients are listed as per the order on pack, from highest quantity to lowest (adapted from Dunnes Stores, 2024).

The branded cookie product is made with fortified wheat flour as the highest quantifiable ingredient. This is followed by milk chocolate chips, sugar and palm oil. In comparison to some of the own labelled products analysed, the ingredient declaration of the branded product is somewhat smaller. However, there are food additives as well as sugar syrups., but given the nature of the product this is expected.

3.6.5 Overall Analysis of Retail Own Brand Chocolate Chip Products

Chocolate Cookies Value Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	1989kJ	2052kJ	2080kJ	2040KJ
Energy kcal	475kcal	490kcal	497kcal	487kcal
Fat	22g	23.7g	25g	23.57g
of which saturates	11g	12.1g	13g	12.03g
Carbohydrate	62g	62.1g	61g	61.7g
of which sugars	32g	27.5g	37g	32.17g
Fibre	4.5g	2.7g	3.5g	3.57g
Protein	6.3g	5.7g	5.3g	5.77g
Salt	0.45g	0.5g	0.65g	0.53g
Cost € per KG	€3.95	€4.40	€6.18	€4.84
Cost € per 100g	€0.40	€0.44	€0.62	€0.48

Table 3.42 The nutritional value of all own brand chocolate cookie products analysed from the value or basic tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

On comparing the three retailers value tier chocolate cookie products, the SuperValu cookies had the highest energy content. However, this is only a 7kcal difference between the Tesco cookies and a 22kcal difference between the Dunnes Stores cookies. The SuperValu value tier cookies also had the highest fat and unsaturated fat quantities, with 3g of fat per 100g of product than the Dunnes Stores cookies. The carbohydrate values of all three retailers value tier cookies are remarkably similar with the difference of a gram between them. The SuperValu value cookies are also higher in sugar, with the Tesco cookies lowest in sugar. The Dunne Stores value cookies are highest in fibre, while the Tesco value cookies are lowest in fibre. In terms of protein, the Dunnes Stores cookies have the highest level of protein but only by a gram more than the SuperValu product. The salt values across all three products are also similar however the SuperValu product has more salt while the Dunnes Stores product has the least. The cheapest option is the Dunnes Stores value cookies, followed by the Tesco cookies, with the SuperValu option being the most expensive.

Chocolate Cookies Core Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	2100kJ	2098kJ	2216kJ	2138KJ
Energy kcal	502kcal	502kcal	530kcal	511kcal
Fat	26g	25.9g	29g	26.97g
of which saturates	14g	13.6g	17g	14.87g
Carbohydrate	58g	59.6g	60g	59.2g
of which sugars	32g	32.5g	44g	36.17g
Fibre	4.1g	3.6g	2g	3.23g
Protein	7g	5.8g	6.3g	6.37g
Salt	0.9g	0.58g	0.56g	0.68g
Cost € per KG	€6.18	€9.75	€7.94	€7.96
Cost € per 100g	€0.62	€0.98	€0.79	€0.80

Table 3.43 The nutritional value of all own brand chocolate cookie products analysed from the core tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

Comparing the three retailers core tier cookie products, the SuperValu product is again higher in energy values. The Dunnes Stores and Tesco products are equal in calories. The SuperValu product is higher in fat, saturated fats, carbohydrates and sugars. The Dunnes Stores cookies have a slightly higher fat and saturated fat value than the Tesco cookies, while the Tesco cookies have a slightly higher carbohydrate and sugar content than the Dunnes Stores cookies. The Dunnes Stores cookies are highest in fibre followed closely by the Tesco product. In terms of protein, the Dunnes Stores product is highest in protein with 1.2g more protein per 100g of product than the Tesco cookies, which are the lowest in protein. Lastly, salt values are similar between Tesco and SuperValu, with the Tesco product having only 0.02g of salt more than SuperValu cookies. The cheapest product on this tier is the Dunnes Stores cookies, while Tesco have the most expensive product.

Chocolate Cookies Premium Tier				
Nutrient	Dunnes Stores	Tesco	SuperValu	Average
Energy KJ	1900kJ	2141kJ	2144kJ	2062KJ
Energy kcal	454kcal	512kcal	513kcal	493kcal
Fat	22g	27.5g	27g	25.5g
of which saturates	13g	16.4g	17g	15.47g
Carbohydrate	58g	58.3g	61g	59.1g
of which sugars	32g	34g	39g	35g
Fibre	2g	3g	1.8g	2.27g
Protein	5.5g	6.3g	5.5g	5.77g
Salt	0.37g	0.43g	0.5g	0.43g
Cost € per KG	€14.54	€11.00	€12.75	€12.76
Cost € per 100g	€1.45	€1.10	€1.28	€1.28

Table 3.44 The nutritional value of all own brand chocolate cookie products analysed from the premium tier. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

On comparing the three retailers premium tier cookie products, the SuperValu product is higher in energy values than the other two retailer's products. The Tesco cookies are the highest in fat, but only by 0.5g more than the SuperValu product. The Dunnes Stores cookies are lowest in fat at 22g. Again, the SuperValu cookies are highest in saturated fats, carbohydrates and sugars. The Dunnes Stores cookies are the lowest in saturated fats and sugars, this product is also the lowest in salt. The Tesco cookies contain the highest amount of fibre; however, this is only by 1g. The SuperValu and Dunnes Stores cookies have the same protein quantity, while the Tesco is 0.8g higher in protein per 100g of product. The most expensive product on this tier is the Dunnes Stores cookies, well the cheapest option is the Tesco cookies.

Chocolate Cookies Own Brand vs Branded				
Nutrient	Value Tier Mean	Core Tier Mean	Premium Tier Mean	Branded
Energy KJ	2040 kJ	2138 kJ	2062 kJ	2022kJ
Energy kcal	487kcal	511kcal	493kcal	483kcal
Fat	23.57g	26.97g	25.5g	22g
of which saturates	12.03g	14.87g	15.47g	11g
Carbohydrate	61.7g	59.2g	59.1g	65g
of which sugars	32.17g	36.17g	35g	31g
Fibre	3.57g	3.23g	2.27g	2.1g
Protein	5.77g	6.37g	5.77g	5.5g
Salt	0.53g	0.68g	0.43g	0.58g
Cost € per KG	€4.84	€7.96	€12.76	€5.00
Cost € per 100g	€0.48	€0.80	€1.28	€0.50

Table 3.45 The nutritional value of all own brand chocolate cookie products analysed from the core tier analysed from the value, core and premium tiers in comparison to a selected branded product. This outlines the average macro nutrient content, overall energy contribution, as well as the fibre and salt level of all.

Overall, the tier with the highest mean energy content is the core tier. This tier also has the highest fat content at a mean value of 26.97g. However the premium tier has the highest saturated fat level, with almost 3.5g more than the value products. The budget or value tier is on average highest in carbohydrates, but the core tier is slightly higher in sugars than the premium tier. The value tier also has the highest fibre values, however this is only by 0.34g. The core tier is also highest in protein and salt. The branded product is most attributed to the value tier, with the exception of the fibre content.

In terms of statistical significance, each energy value, macronutrients and micronutrients were analysed between each of the three tiers using the mean value calculated across the three retailers. In terms of energy (KJ), the p value calculated between the mean own brand value and core tiers was $p=0.11$. The p value calculated between the core and premium tier was $p=0.44$. While the p value calculated between the value and premium tier had the highest p value at $p=0.81$. Overall, the p values calculated for the energy in KJ was not

tested as statistically significant. There was also no correlation between price and energy content found across the three retailers, as illustrated in Figure 3.17 below.

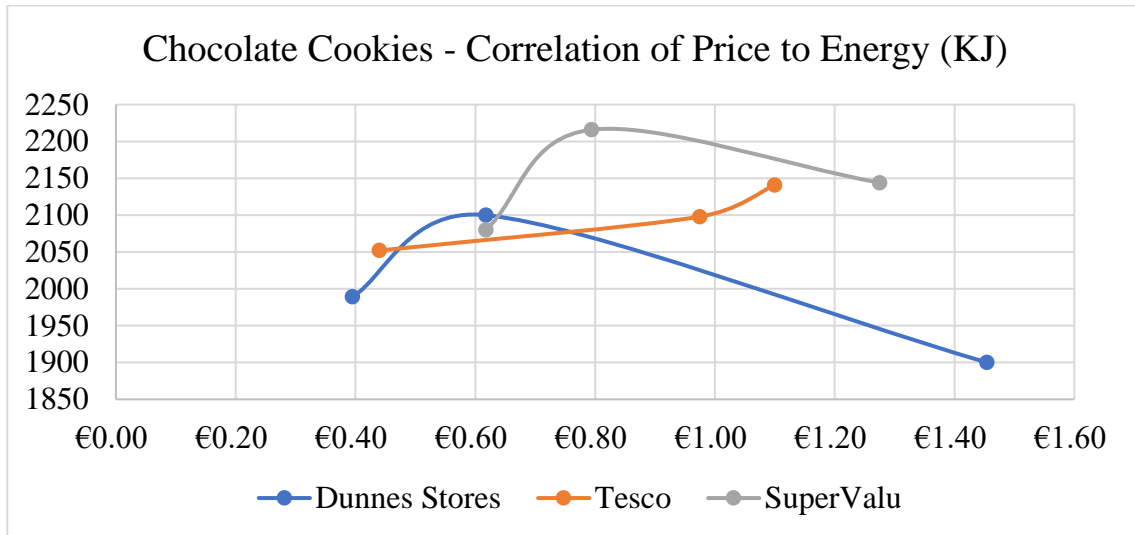


Figure 3.17 The correlation of the energy content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores have a slight incline in energy value with the first price increase, this however, then drops below the first energy value with the third price increase, giving no correlation between energy content and price. Tesco has a slight positive correlation, with the energy value increasing with the price of the products. SuperValu also has an increase in energy with the increase of price, this however then drops between the two previous energy levels as the price increases again. As the energy expressed as kcal is the same as energy in KJ, this can be presumed as the same.

In terms of fat content, the p value calculated between the mean own brand value and core tiers was $p=0.06$. The p value calculated between the core and premium tier was the highest at $p=0.51$. While the p value calculated between the value and premium was $p=0.38$. Overall, the p values calculated for the fat content was not tested as statistically significant. There was also very little correlation between price and fat content found across the three retailers, as shown in Figure 3.18 below.

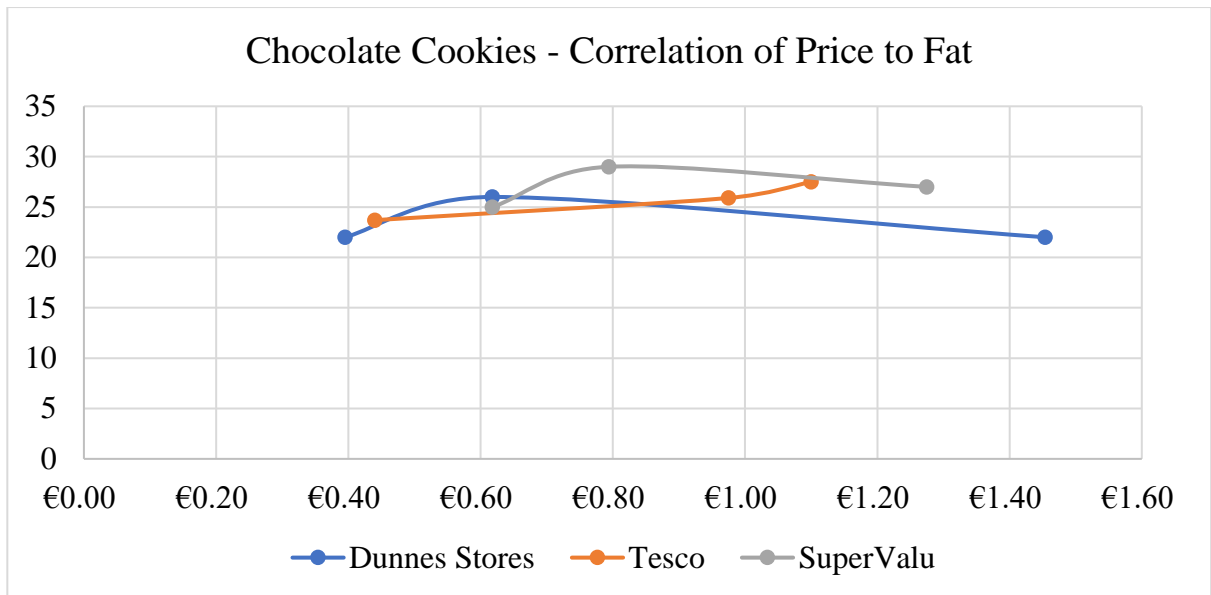


Figure 3.18 The correlation of the fat content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores have a slight incline in fat content with the first price increase, this however, then drops back to the same fat value with the third price increase, giving no correlation between fat content and price. Tesco has a slight positive correlation, with the fat content increasing with the price of the products. SuperValu also has an increase in fat content with the increase of price, this however then drops between the two previous fat content levels as the price increases again.

The p value calculated between the mean own brand value and core tiers in terms of saturated fat, was $p=0.08$. The p value calculated between the core and premium tier was the highest at $p=0.73$. While the p value calculated between the value and premium was $p=0.06$. Overall, the p values calculated for the saturated fat content was not tested as statistically significant. There was also very little correlation between price and saturated fat content found across the three retailers, as shown in Figure 3.19 below.



Figure 3.19 The correlation of the saturated fat content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores have an increase in the contents of saturated fats with the first price increase. However, this has a slight decline with the second increase to price, giving no correlation between the saturated fat content and price. Tesco has a positive correlation, with the saturated fat content increasing with the price of the products. SuperValu also has an increase in saturated fat content with the increase of price, this however, remains at the same saturated fat content level as the price increases again.

In terms of the carbohydrate content, the p value calculated between the mean own brand value and core tiers was $p=0.02$. The p value calculated between the core and premium tier was the highest at $p=0.93$. While the p value calculated between the value and premium was $p=0.06$. The p values calculated for the fat content between the value tier and the core tier, as well as the value tier and the premium tier was tested as statistically significant. The p value calculated between the core tier and the premium tier was not tested as statistically significant. There was a correlation between price and carbohydrate content found across the three retailers, illustrated in Figure 3.20 below.

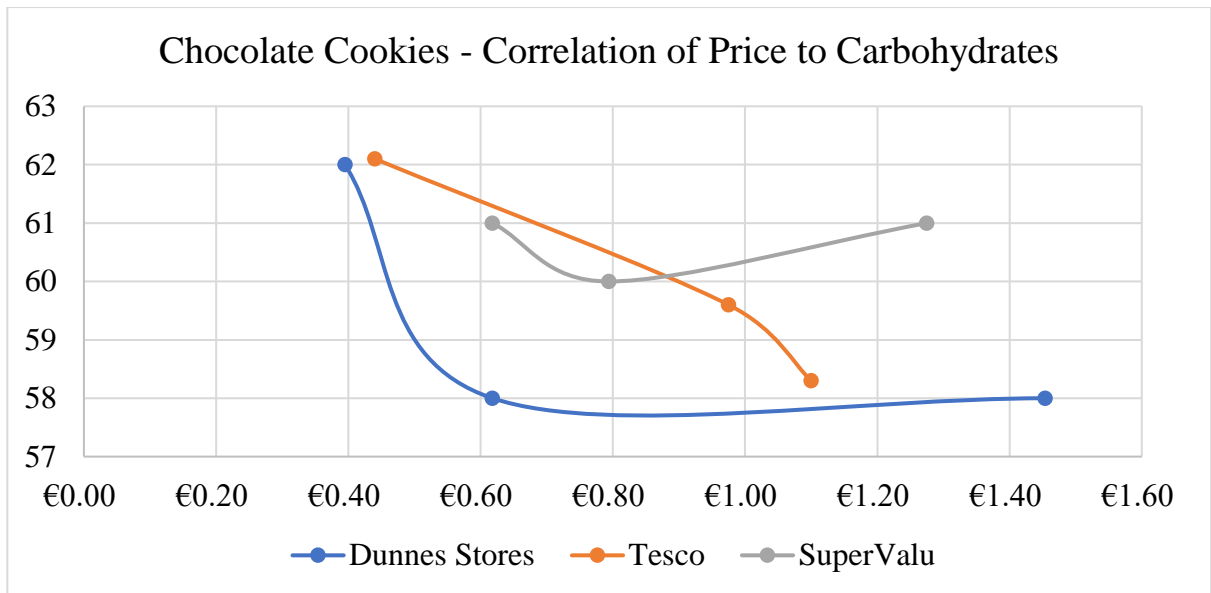


Figure 3.20 The correlation of the carbohydrate content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores had a large decline in carbohydrates with the first price increase. However, the carbohydrates increase slightly with the next price increase, giving no correlation. Tesco has a very strong, almost linear, negative correlation, with the carbohydrate content decreasing while the price increases. SuperValu also has a decrease in carbohydrate content with the first increase of price, this however the carbohydrates increase slightly with the next price increase, giving no correlation. This is very similar to the Dunnes Stores line of progression.

The p value calculated between the mean own brand value and core tiers in terms of sugars, was $p=0.45$. The p value calculated between the core and premium tier was the highest at $p=0.80$. While the p value calculated between the value and premium was $p=0.45$. Overall, the p values calculated for the sugar content was not tested as statistically significant. There was, however, some correlation between price and sugar content found across the three retailers, as shown in Figure 3.21 below.

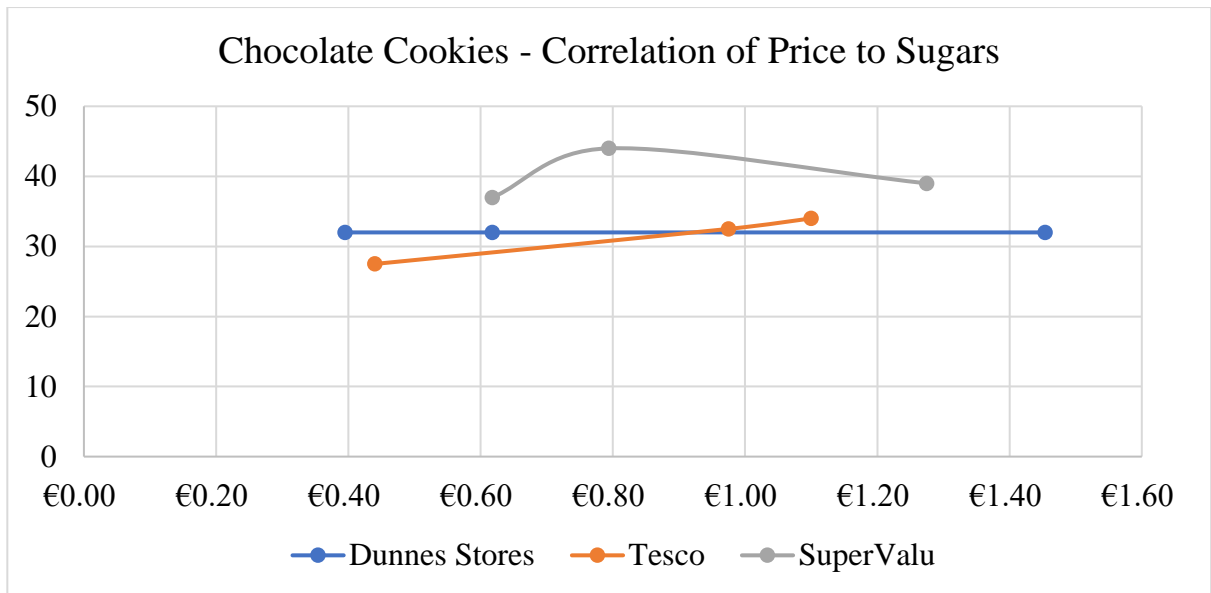


Figure 3.21 The correlation of the sugar content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores had no change in the sugar quantities across the three tiers. While Tesco had an almost linear, positive correlation, with the sugar content increasing with the price of the products. SuperValu also had an increase in the sugar content with the increase of price, this however then starts to drop back and decrease as the price increases again.

The p value calculated between the mean own brand value and core tiers in terms of fibre, was $p=0.71$. The p value calculated between the core and premium tier was $p=0.26$. While the p value calculated between the value and premium was $p=0.11$. Overall, the p values calculated for the fibre content was not tested as statistically significant. There was, however, some correlation between price and fibre content found across the three retailers, as shown in Figure 3.22 below.

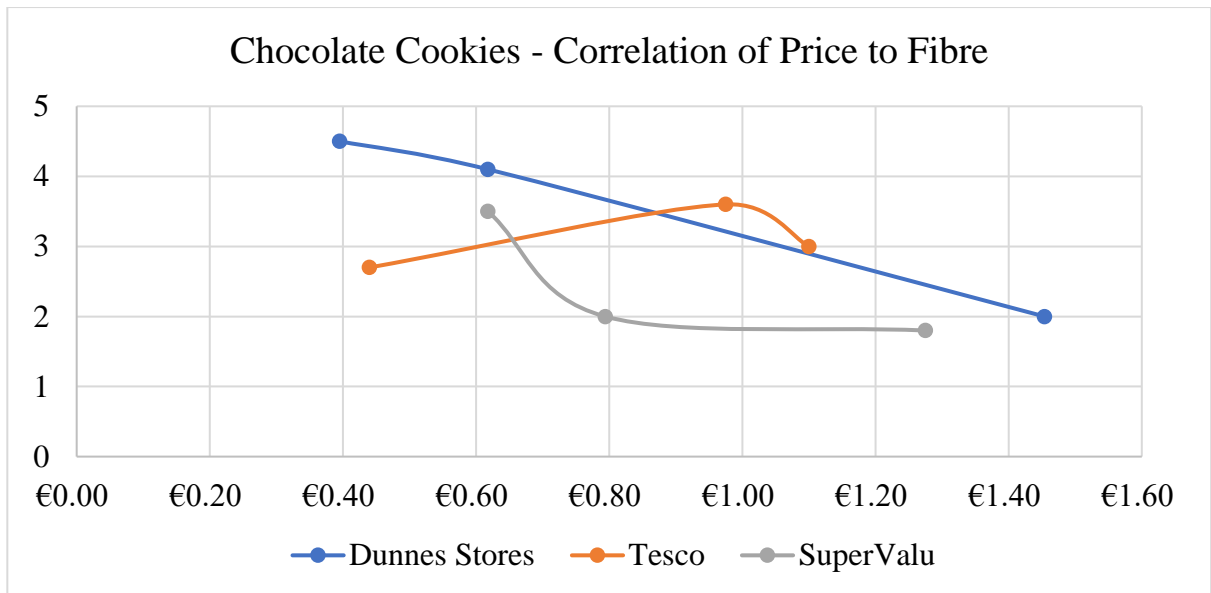


Figure 3.22 The correlation of the fibre content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores had an almost linear, negative correlation between the fibre content and the price. As the price decrease, so too does the fibre content. Tesco has an initial incline in the fibre content with the price, however, there is no correlation here as the fibre decreases with the second price increase. SuperValu has a slight negative correlation, with a steep decline in the fibre with the first price increase. The second price increase sees a very small fibre content decline.

The p value calculated between the mean own brand value and core tiers in terms of protein, was $p=0.26$. The p value calculated between the core and premium tier was $p=0.24$. While the p value calculated between the value and premium was $p=0.99$. Overall, the p values calculated for the protein content was not tested as statistically significant. There was also very little correlation between price and protein content found across the three retailers, as shown in Figure 3.23 below.

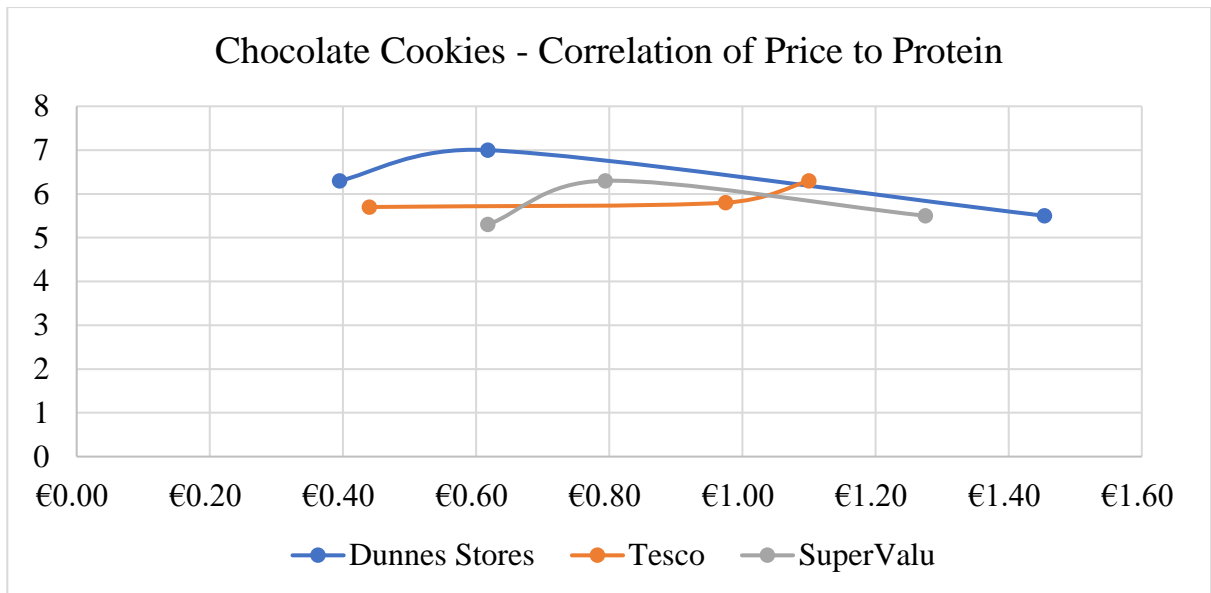


Figure 3.23 The correlation of the protein content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores at first have an increase of protein with price. This however decreases greatly with the next price increase, giving no correlation. Tesco have a very slight positive correlation between the protein content and price of the products. As the price increases, the protein increase also SuperValu is similar to Dunnes, with an increase of protein with price at first. This also then decreases greatly with the next price increase, giving no correlation.

The p value calculated between the mean own brand value and core tiers in terms of salt, was $p=0.31$. The p value calculated between the core and premium tier was $p=0.10$. While the p value calculated between the value and premium was $p=0.23$. Overall, the p values calculated for the salt content was not tested as statistically significant. There was also very little correlation between price and salt content found across the three retailers, as shown in Figure 3.24 below.

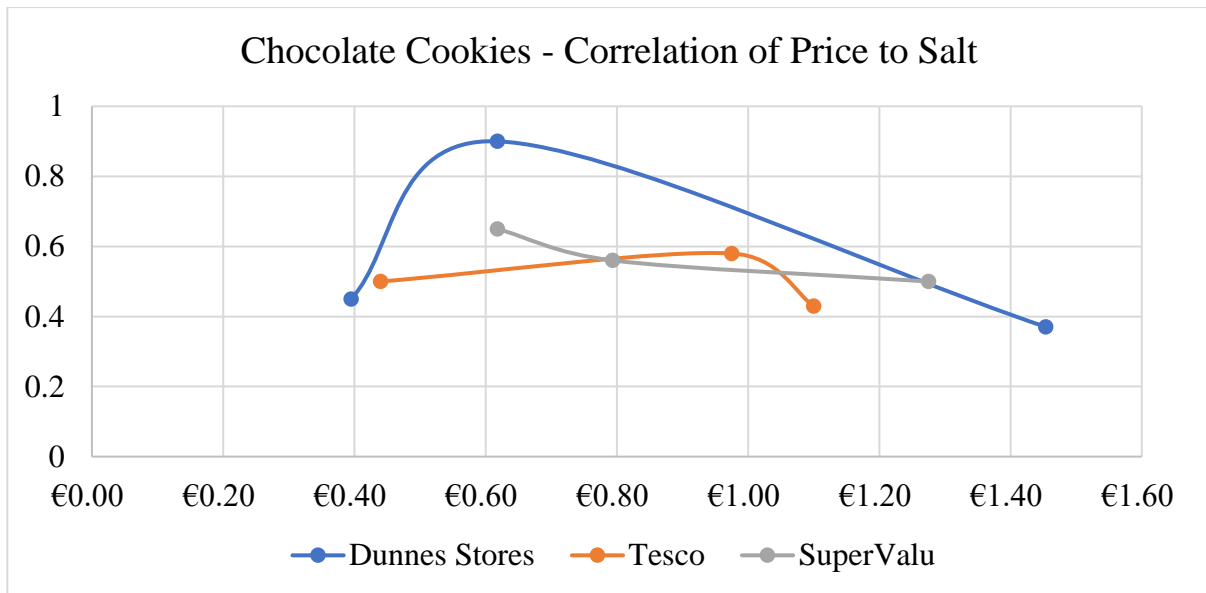


Figure 3.24 The correlation of the salt content and price of Dunnes Stores, Tesco and SuperValu own brand chocolate cookie products across each tier.

Dunnes Stores at first have a large increase of salt with price. This however decreases significantly with the next price increase, giving no correlation. Tesco have a very slight incline in the salt content with the first price increase. This however the decreases with the next price increase, giving no correlation. SuperValu has a negative correlation, as the price increases, the salt content increases.

3.7 Synopsis of Major Findings

The only statistically significant difference between the own brand wholemeal breads analyses was the carbohydrate content between the mean own brand value and core tiers. There was no other statistically significant data established for this product. However, there were positive correlation between the energy and fat content and price of all there retailers wholemeal bread products. The own brand wholemeal breads across the retailer's value tier were very similar in their nutritional values. However, in the core tier, the own brand wholemeal breads, there were noticeable differences between the retailers. The Tesco product was higher in sugar, which slightly skewed the average sugar value for this tier. In the premium tier, again the Tesco nutrition was higher in each nutrient other than the sugar and salt value. In comparing the mean values of each of the retailer's value, core and premium wholemeal bread products to the branded product selected, the branded product

does not match up directly with one of the tiers but could be considered most similar to the value tier.

For the analysis of the retailer's own brand strawberry yogurt products, it was found that there was no statistically significant difference between the own brand core tier and the premium tier products. In addition to this, as there were only two data points to calculate the correlation, the only way that there would be no correlation was if the nutritional content remained the same in both products as with the case with the Fibre in the SuperValu product.

For the analysis of the retailer's own brand chocolate cookie products, it was found that in terms of the statistical analysis, it was found that the only statistically significant difference was between the value and core tier in terms of carbohydrates. The value tier had a mean carbohydrate value of 61g per 100g of product while the core tier had a mean carbohydrate value of 59.2g per 100g. In addition to this, there was very little correlation found between price and nutritional content of the retailer's own brand cookie products. The Tesco products had a positive correlation for the energy values, fat, saturated fat, sugar and protein values, meaning these values increased with the price. This supports the analysis results of the Tesco own brand products, in that the value product was more beneficial than the premium product. Both Dunnes Stores had no positive correlation between price and nutritional contents in their products. The nutrition fluctuated between each tier in terms of energy, fat, saturated fat, sugars and protein.

Chapter 4

Discussion

The purpose of this thesis was to review the cost of retailer own brand products with respect to their nutritional content and cost. This was achieved through collecting and analysing the nutritive value, as well as the cost of own brand in addition to branded products. The focus of the thesis was on the three-tiered system used in retail own brand label product lines. This included a budget range, a core range and a premium range. The objective of this analysis was to determine whether there is a link between low-cost food and nutritionally linked diseases such as obesity, heart disease and some cancers. The focus of the analysis was on the macronutrients provided by each product, and the energy value contributed by each macronutrient to the calorific value of the overall product. Products for the analysis were selected based on relevant tiers of the food pyramid to determine the category of food, as well as current market trends in Ireland in correlation with consumption. The food pyramid was utilised in this analysis as in order to achieve a healthy diet, a balance of certain nutrients must be obtained on a regular basis and the food pyramid illustrates how to make this achievable. The analysis of food products was based on a 38-year-old female, with low to average physical activity levels, as this was the category of person most likely to be grocery shopping in Ireland. It was investigated if there is any correlation between the nutritional content of the selected products and the price. The ingredients, including additives were also analysed in order to investigate the benefits of each product respectively.

In total, 27 products were analysed, including retailer own brand products and branded products. Statistical analysis has been carried out as part of this thesis due to the availability of raw data. The null hypothesis of this analysis is that there is no correlation between the cost of retailer's own brand food products and the nutritional quantity provided by each tier. The alternative hypothesis is that there is a correlation between the cost of retailer's own brand food products and the nutritional quantity provided by each tier. The significance or alpha value (α) used in this analysis is $p < 0.05$ significance level. If the p-value is less than the significance level then the null hypothesis must be rejected. If the p-value is more than the significance level then the null hypothesis must be accepted.

In order to analyse retailers own brand products, it is important to evaluate the current retail environment. While the concept of buying and selling food in a 'retail' environment can be traced back thousands of years to ancient Rome when food was traded and sold in markets, it is the last century where we can see the current retail market form. In Stanton's *A History of Retail*, the stepping stone of each retail stage has been outlined into particular eras.

Beginning in the early 1800's with the corner store era, stores used to sell only a small selection of essential grocery items. In the mid 1850's stores developed into chain stores. It is during the era that the standardisation that is still present in today's retail environment first started to emerge. After the second World War, due to an end to rationing, the self-service model of retail arrived in Ireland. This structure of shopping where the customer peruses the shelves and selects their own products is utilised to this day and will can have a great impact on the choices customers are making about the produce they are purchasing. Dunnes Stores was the first retailer to utilise this self-service model in their stores in Ireland. The retail market in Ireland has evolved from Irish startups such as the Musgrave group, H Williams and Co, Superquinn and SuperValu. However, the retail market in Ireland is also made more competitive with the arrival of global retailers. In 1979, Marks and Spencer's set up a branch in Ireland. Then, in 1997, retailer giant Tesco began to open multiple stores in Ireland. Discounters such as Aldi and Lidl established themselves in the early 2000s. These discounters were successful in gaining market share during the 2009 recession, due to their ability to offer lower prices.

The current era of retail is the online era. Today's consumers value convenience, with many customers looking to have their weekly shop carried out without ever having to step foot in a shop. This demand for online shopping was dramatically increased by the Covid-19 pandemic, due to the need to reduce contact with other people. This need has quickly developed into a habit for many shoppers. It is important to note that there is no definite timeline between each era discussed. There is a cross over of one era beginning and another ending. The retail environment also differs greatly depending on the geographical region (Stanton, 2018). The current retail market in Ireland is made up of five key retailers, in addition to an amalgamation of smaller retailers and stores. These main retailers are Dunnes Stores, Tesco, SuperValu, Lidl and Aldi. The retail market in Ireland is a competitive one, with €3 billion spent in grocery stores in the first quarter of 2023 alone (CCPC, 2023). While the Irish market has fluctuated greatly over the last 10 years, the top three retailers have managed to retain their spot. Dunnes Stores currently holds the most market share at 24.3% of the market. This is closely followed by Tesco at 23.5% and SuperValu at 20.6% of the market.

The economic state of the country can have a great impact on the retail environment and consumer spending habits. As aforementioned, the discounter stores such as Lidl and Aldi stores became increasingly popular in Ireland throughout the recession in 2009 due to their

reduced-price offerings (Hennessy, 2021). This gives an insight into the motivations behind consumer choices. It could be suggested that consumers look to reduce their food bill in times of economic hardships as opposed to reducing other bills. The current economic climate in Ireland is certainly having an impact on consumer choices. While the cost of living can fluctuate, it has been consistently increasing in the last two decades. In 2021, Ireland was ranked sixth in term of highest food costs in Europe out of thirty-six countries (CSO, 2022). When comparing the cost of food in February 2023 and February 2024, the cost of food in Ireland increased by 4% (Trading Economics, 2024). This increase in food prices has altered consumer spending habits which has had an impact on the sales of retail own brand products. Retail own brand products are those products that have been produced and packed under the name of the retailer (Sutton-Brady *et al*, 2017). According to Bord Bia, retail own brand products have been growing in popularity at a steady rate of about 4% a year across Europe (Bord Bia, 2019). This growth can be attributed the consumers desire for cheaper products, as well as the ability of retailers to capture areas that traditional brands fall down in, and by offering consumers reduced prices for own brand products.

In the past, own brand products had negative connotations and were seen as a poor quality, cheaper option. Many retailers struggled to gain market share with their own brand products, with Irish consumers loyalty attributed to well-known branded products (Pope, 2022). In 2005, approximately only 9% of products purchased were own brand products. During the recession in Ireland from 2007 to 2009, this figure rapidly increased to 35% of products purchased (Leonard, 2011). In 2022, this figure increased again to 46%, possibly attributed by the Covid-19 pandemic, when many people were out of work. According to Kantar statistics, May 2023 was the first time that branded and own brand products were on equal ground in term of market share (Healy, 2023). Retailers have developed their own brand ranges into a tiered system consisting of three tiers: a value, basic tier; a core or average tier; and a premium, high-quality tier. Retailers such as Tesco, SuperValu and Dunnes Stores have introduced a tiered system into their own brand lines, in order to offer products to all types of consumers.

Anchor pricing must be considered when analysing the own brand core products. This is a pricing strategy, in which the retailer uses human nature against the customer. It is possible to postulate that consumers have aversions to extremes, and therefore will automatically go for the middle tier range, as the value tier may have the perception of poor quality due to the reduced cost (Pope, 2022). The premium tier could be viewed as too expensive, and it

also has the effect of making the middle, core range look like a cheaper product, giving the consumer the perception that they will save money if they go for the middle, core range. The important thing regarding this is if the consumer is always picking the core product as they believe this product is the best offering, is the nutritional content of these products reflecting the price or are retailers using this strategy to market less nutritionally beneficial products to a larger consumer base. The complexity of consumer demand will also have an impact on the pricing strategy that retailers will utilise in their shops. Consumers trends and demands are constantly evolving, from farm to fork traceability, to a growing desire for plant-based foods. Retailers must keep up with consumer demand in order to remain competitive. By developing their own brands in respect to current retail trends, retailers will more likely succeed in attaining more market share. The data presented in Figure 1.5, illustrating the fluctuation of the market share of branded and own brand products in Ireland from 2005 to 2024 gives evidence to the importance of own brand products in the current retail environment. Branded and own brand products currently have an equal market share. It remains to be seen if the own brand products will for the first time, gain more market share than the branded aspect of retail. However, the dramatic shift in the market gives evidence to the consumers desire for less costly products.

In 2016, due to EU legislation, it became mandatory for food business operators to display the nutritional information of prepacked food products on packaging (Food Safety Authority of Ireland, 2023). This legislation applies to both own brand and branded products, and it is the responsibility of the food business operator to ensure that true and accurate information is displayed on prepacked food. The nutritional information must be outlined on pack. Per 100g of the product. The nutrients that must be declared are the essential nutritional elements, which include, energy value in kilojoules (KJ) and kilocalories (Kcal), fat, saturated fat, carbohydrates, sugars, protein and salt. It is these nutritional elements that are analysed as part of this thesis, to determine whether the value products have more or less of each nutrient in comparison to the core and premium products. The nutritional content of food products is important, as it is essential that the required intake of each nutrient is consumed, and not overconsumed in order to maintain a healthy diet. The recommended daily amount is an important aspect of ensuring a healthy diet, consisting of a balance of certain nutrients, that each have a particular function in the human diet, are obtained on a regular basis. The recommended intake will vary based on a person's age, gender, dietary customs, level of physical activity and lifestyle. The amount of each individual nutrient

needed to maintain an individual's health is called the nutrient requirement (EFSA, 2024). According to the EFSA, an average 38-year-old female, with low to average physical activity levels should intake approximately 45-60% of their energy intake from carbohydrates, and 20-35% of the energy intake from fat. Energy is derived from the nutrients which are broken down, metabolised by the body and converted into energy in a form that can be utilised by human cells (Insel, 2014). Carbohydrates and protein provide 4kcal per gram and fat provides 9kcal per gram as illustrated in Table 1.7. Energy balance is an imperative aspect of maintaining a healthy weight. By consuming more energy than is needed, the body stores this energy as excess fat, therefore, the amount of energy consumed should be managed in relation to your physical activity levels, age, weight and gender.

The Irish government have established keyways in which they aim to improve the eating habits of the nation, beginning with educating citizen from a young age. The food pyramid is used as a demonstration tool that is often taught at primary school level, to ensure consumers are educated on the array and quantity of each foods that should be consumed in order to achieve a healthy and balanced diet, as well as to prevent or reduce the risk of developing food related diseases or disorders (Sarac et al, 2020). Legislation regarding ingredient declaration on prepacked foods is also another way of empowering consumers in their food choices. In today's global environment, processed foods have become essential in maintaining current food distribution models. Food business operators must declare the ingredients used to form the product, including food additives which must be declared and grouped according to function, followed by the name or its E number.

Food additives have functional roles in food. In the analysis of the food products as part of this thesis, the most common food additives observed were natural flavourings, preservatives, acidity regulators, emulsifiers, modified starches, stabilisers and flour enhancers. Food additives can be natural or synthetic. Synthetic or artificial additives are those that have been chemically made to perform a function in food manufacturing. According to Trasande, *et al*, there has been an increase in the scientific evidence on synthetic food additives and the potential negative implications that these can have on health, particularly in children and in the last two decades research has shown that consumption of food with these synthetic additives is higher in low-income populations (Trasande, *et al*, 2018). In analysing the ingredient declarations of all the products selected from each tier, it was found that the value and core products in the retailer's own brand

range, consisted of more food additives than the own brand premium or branded products. The findings here support the findings of Trasande, L, *et al*, 2018.

Another important aspect of improving the consumers health through diet is food fortification. Food fortification improves the nutritional content of foods through the deliberate addition of macronutrients or micronutrient (World Health Organisation, 2024). Through analysis of the retailer's own brand wholemeal bread products, fortified flour, which is fortified through the addition of micronutrients such as calcium and thiamine, was utilised in every tier, value, core and premium. Adversely, the branded product was the only bread product analysed that did not contain fortified flour. This suggest that retailer own brand products could potentially have more benefits for consumers in terms of nutrition, than the long-standing branded products.

The government intervention in the promotion of balanced and health eating became imperative due to the shift in disease in Ireland, and globally. While 2,000 years ago, epidemic diseases such as cholera, bubonic plague, measles and smallpox were highly rampant, in today's world, particularly in developed countries such as Ireland, health issues have evolved to become more dietary or nutritional related. In 2019, over 35% of all deaths in Ireland linked to behavioural risk factors, such as smoking, poor diet, alcohol consumption and low physical activity. Dietary risks including low fruit and vegetable intake, high sugar and salt consumption, were estimated to account for approximately 13 % of these deaths (European Observatory on Health Systems and Policies, 2021). Obesity has particularly become a health, issue as people who are obese are more at risk of cardiovascular disease, high blood pressure and diabetes (HSE, 2024). According to the Healthy Ireland framework for improved health and wellbeing 2013-2025, 61% of all adults in Ireland are overweight or obese. This is an extortionate percentage of the population, with three out of every four people over the age of fifty being overweight (Department of Health, 2019). It was also found that the most at risk of obesity in our society are female children and those in a lower income social class (O'Donnell et al, 2020). It is imperative to establish the cause for the link between the prevalence in obesity and lower income class groups. Is spending less on the food consumed reducing the nutritional value gleamed is the aim of this thesis to assess. These dietary related disease increase the pressure on the health service in Ireland, and therefore government intervention in imperative. The Sláintecare reform programme with the aim to transform how health and social care services are delivered,

including an increase of funds to support the Healthy Ireland initiative that was established in 2013, which prioritises preventing the main causes of preventable deaths.

The food reformulation roadmap in an additional way in which Healthy Ireland and the FSAI aim to improve the diet of the population. The aim of this roadmap is to develop a strategy to reduce the energy, sugar, fat and salt content of food by the end of 2025. This is currently a strategy that food business operators are implored to establish in their business, however it is not yet legislation. The main goal of the initiative is to reformulate existing products in the market to reduce energy and sugar values by 20% and fat and salt values by 10%. The concern in relation to this strategy is that as it is not yet legislation, food businesses don't not have to establish this in their business, and the incentive to do so is not currently there. While consumer demand may show a preference for healthier food cleaner labels, the costs involved in reformulating existing products to meet the goals could be a deterrent for the food operators.

In order to analyse an array of different products, the food pyramid was utilised as a tool in order to select products for analysis. Processed foods with varying nutritional values were analysed in order to ensure results were more accurate. The shelves selected for analysis included shelf two which outlines wholemeal cereals and breads, shelf three which outlines dairy products such as milk and yogurt, and finally the top shelf of the food pyramid which includes the products that should not be eaten in excess, including chocolate and biscuits. Certain shelves of the food pyramid were excluded due to the fresh nature of the products. Non processed foods will have the same nutritional values generated from similar databases such as Nutricalc. In total, 27 products were analysed across own brand products and branded tiers. Statistical analysis has been carried out as part of this study due to the availability of raw data. The null hypothesis of this analysis is that there is no correlation between the cost of retailer's own brand food products and the nutritional quantity provided by each tier. The alternative hypothesis is that there is a correlation between the cost of retailer's own brand food products and the nutritional quantity provided by each tier. The significance or alpha value (α) used in this analysis is $p < 0.05$ significance level. If the p-value is less than the significance level than the null hypothesis must be rejected.

Wholemeal bread was the product analysed from the second shelf of the food pyramid. The first retailer analysed was Dunnes Stores. The products selected from this retailer, as outlined in Table 3.2, were Dunnes Stores Basic Brown Sliced Pan 800g, Dunnes Stores

Wholemeal Sliced Bread 800g and Dunnes Stores Simply Better Handmade Wholemeal Sliced Bread 400g. Upon analysis of the nutritional content of the three tiers it was found that the Dunnes Stores core product was most beneficial, followed closely by the premium product, with the value product being the least beneficial. However, upon analysis of the ingredient declaration of each product, it was found that the premium product utilised more natural ingredients, with less food additives than the other two products. The ingredient declarations of the core product illustrated that this product contained more food additives than the other two products. Therefore, it was established that in term of Dunnes Stores own brand products, the premium product was the most beneficial overall, while the value product was the least beneficial.

The products selected from Tesco for analysis on this shelf of the food pyramid, as outlined in Table 3.5 were Tesco Family Brown Sliced Pan 800g, Tesco Farmhouse Wheaten 500g and Tesco Finest Super Grained Loaf 600g. Upon analysis of the nutritional content of the three tiers it was found that the Tesco premium product was the most beneficial, followed by the core product, with the value product established as the least beneficial product. The premium tier product was higher in complex carbohydrates than the other two tiers, it was also higher in fibre and protein. This was attributed to the presence of seeds in the ingredient declaration of the premium product.

The products selected from SuperValu for analysis on this shelf of the food pyramid, as outlined in Table 3.8 were SuperValu Wholemeal Brown Bread 800g, SuperValu Brown Sliced Pan 800g and SuperValu Stoneground Wholewheat Bread 454g. Upon analysis of the nutritional content of the three tiers it was also found that the SuperValu premium product was most beneficial, while the core product followed second, with the value product being the least beneficial. It was found upon analysis of the ingredient deceleration of the value and core tier that these products were almost identical in their ingredients, with the only exception of an additional preservative in the value tier product.

Upon analysis of the three retailers accords the value tier products, it was found that all three retailers value products were very similar in nutritional content and ingredient declarations, with negligible differences. This gives the impression that the value tier consists of an established, basic recipe. There was a variation between the costs of the products per retailer. The Dunnes Stores and Tesco value wholemeal bread product were equal in price, while the SuperValu product was the most expensive product.

Upon analysis of the three retailers accords the core tier products, it was found that the Dunnes Stores product was the most beneficial product on offer at this tier due to the lower saturated fat and sugar content, in addition to the high fibre values. The SuperValu was found as the second most beneficial, with the Tesco core product being the least beneficial due to higher saturated fat and sugar levels, and this product was also lower in fibre. Dunnes Stores had the cheapest product on this tier. Tesco was the most expensive product.

Upon analysis of the three retailers accords the premium tier products, it was established that the Tesco product was most beneficial due to the presence of unsaturated fats, complex carbohydrates and high fibre. The Dunnes Stores and SuperValu products were again very similar on this tier, with negligible differences. The Tesco product was the most expensive product while the SuperValu product was the cheapest.

In comparing the branded product, Brennans Be Good Wholemeal Delicious High Fibre Bread 600g, it was found that the branded wholemeal bread product could be most attributed to the mean value tier nutritional values, with the least similarity with the premium tier. While branded products are often marketed as a premium product, in this case, the branded product was most similar to the retailers overall average values of the value tier.

In terms of the statistical analysis, it was found that the only statistically significant difference was between the value and core tier in terms of carbohydrates. The value tier had a mean carbohydrate value of 42g per 200g of product while the core tier had a mean carbohydrate value of 38.53g per 100g. Upon analysis of this sugar content of 3g in the value tier and 3.5g in the core tier, it is possible to postulate that the value tier, in terms of statistical significance, has more complex carbohydrates than the core tier. The results of this analysis were very skewed, with p values ranging from $p=-0.049$ to $p=0.92$ as outlined in Table 4.1.

Wholemeal Bread P values			
Nutrient	Value vs Core	Core vs Premium	Value vs Premium
Energy	p=0.15	p=0.27	p=0.30
Fat	p=0.31	p=0.27	p=0.21
Saturated Fat	p=0.34	p=0.35	p=0.18
Carbohydrates	p=0.049	p=0.21	p=0.92
Sugars	p=0.41	p=0.09	p=0.08
Fibre	p=0.73	p=0.79	p=0.21
Protein	p=0.34	p=0.73	p=0.47
Salt	p=0.57	p=0.45	p=0.40

Table 4.1 The p-values calculated upon analysis of retailer's own brand wholemeal bread products. Products were compared by a tier basis.

The correlation between the nutrients per tier and the cost of each product was also analysed, the results of which are outlined in Table 4.2. It was found that all three retailers had a positive correlation in relation to energy and fat. This established that as the price increased, so too does the content of energy and fat. Tesco was the only retailer who had a positive correlation in saturated fats. While Dunnes Stores and Tesco had no correlation between the content of saturated fats and the price of the product. Dunnes Stores wholemeal bread had a negative correlation in carbohydrates, as the price increased, the content of carbohydrates reduced. Tesco had no correlation between carbohydrates and price while SuperValu had a positive correlation. There was no correlation established in sugars or fibre across the three retailers, while Dunnes Stores was the only retailer with a positive correlation in the protein and price. Finally, the correlation between salt and price varied in all three retailers, with the Dunnes Stores products reducing in salt as the cost increases, the Tesco product having no correlation and the SuperValu products increasing in salt as the price increase.

Wholemeal Bread Correlation			
Nutrient	Dunnes Stores	Tesco	SuperValu
Energy	Positive Correlation	Positive Correlation	Positive Correlation
Fat	Positive Correlation	Positive Correlation	Positive Correlation
Saturated Fat	No Correlation	Positive Correlation	No Correlation
Carbohydrates	Negative Correlation	No Correlation	Positive Correlation
Sugars	No Correlation	No Correlation	No Correlation
Fibre	No Correlation	No Correlation	No Correlation
Protein	Positive Correlation	No Correlation	No Correlation
Salt	Negative Correlation	No Correlation	Positive Correlation

Table 4.2 The correlation between the nutritional contents of retailer’s own brand wholemeal bread products and the cost of these products.

The overall result of this analysis suggests that the energy content and fat content of retailer’s own brand wholemeal bread will increase with the price of the product. It could also be said that there is no correlation between the sugar and fibre content of retailer own brand products in comparison to price. In terms of the other nutrients, as the correlation varied between each retailer it is difficult to make a determined assumption. However, the analysis of each retailer own brand wholemeal bread products established that the premium product was the most beneficial, the core product was the second most beneficial and the value product was the least beneficial, across all three retailers when nutrition and ingredients are taken into account. The findings here support the findings of O’Donnell *et al*, 2020, that those in a lower income social class are most at risk of obesity.

The product selected from the third shelf of the food pyramid was strawberry yogurt. The value tier offering of strawberry yogurt in all three retailers was not comparable to the products on offer in the core or premium tiers due to the products being formulated to be low in fat, or a different format of yogurt such as Greek style yogurt. Therefore, only two tiers were analysed for this product., The two products analysed form Dunnes Stores was Dunnes Stores Rich & Creamy Senga Strawberry Yogurts 500g (4x125g) and Dunnes Stores Simply Better Rich & Creamy Yogurt with Irish Strawberries 450g. Upon analysis of these

products, it was found that the core product was slightly more beneficial in terms of nutritional content and ingredient declaration than the premium product.

The products selected from analysis from Tesco were Tesco Senga Strawberry Yoghurt 150g and Tesco Finest Senga Strawberry Heritage Raspberry 150g. It was established that the premium product from this retailer was more beneficial due to the lower saturated fat and sugar content in the premium product than the core. The products selected from analysis from SuperValu were SuperValu Organic Strawberry Yogurt 450g and SuperValu Signature Tastes Strawberry Yogurt 140g. The most beneficial product established here was the core product, with the premium the least beneficial upon analysis of the nutritional content and ingredients. The premium product was much higher in sugar than the core product and as established, too much added sugar can lead to raised blood pressure in addition to weight gain.

Upon analysis of the three retailers across the core tier products, it was found that the SuperValu product was most beneficial, with the Tesco product the least beneficial on this tier. The SuperValu product was also the cheapest on this tier, while the Tesco product was the more expensive product. The analysis of the three retailers across the premium product resulted in the Tesco product being the most beneficial, with the Dunnes Stores product being the least beneficial. However, the Dunnes Stores product was the cheapest product here, while the SuperValu product was the most expensive. This analysis illustrated that in terms of retailer's own brand strawberry yogurt, the core tier was more likely to be beneficial than the premium tier, However, when the branded product was analysed in comparison to the retailer's own brand strawberry yogurt, it was found that this product was neither the most expensive or the cheapest option, but it was the most beneficial in terms of the ingredient declaration and the nutritional quantities.

In terms of the statistical analysis, it was found that there was no statistically significance difference between the own brand core tier and the premium tier products. The results of this analysis were very skewed, with p values ranging from $p= 0.32$ to $p= 0.86$, as illustrated in Table 4.3.

Strawberry Yogurt P values			
Nutrient	Value vs Core	Core vs Premium	Value vs Premium
Energy	n/a	p=0.41	n/a
Fat	n/a	p=0.35	n/a
Saturated Fat	n/a	p=0.56	n/a
Carbohydrates	n/a	p=0.55	n/a
Sugars	n/a	p=0.86	n/a
Fibre	n/a	p=0.73	n/a
Protein	n/a	p=0.32	n/a
Salt	n/a	p=0.42	n/a

Table 4.3 The p-values calculated upon analysis of retailer's own brand strawberry yogurt products. Products were compared by a tier basis.

The correlation between the nutrients per tier and the cost of each product was also analysed, the results of which are outlined in Table 4.4

Strawberry Yogurt Correlation			
Nutrient	Dunnes Stores	Tesco	SuperValu
Energy	Positive Correlation	Negative Correlation	Positive Correlation
Fat	Positive Correlation	Negative Correlation	Positive Correlation
Saturated Fat	Positive Correlation	Negative Correlation	Positive Correlation
Carbohydrates	Positive Correlation	Negative Correlation	Positive Correlation
Sugars	Negative Correlation	Negative Correlation	Positive Correlation
Fibre	Negative Correlation	Positive Correlation	No Correlation
Protein	Negative Correlation	Negative Correlation	Positive Correlation
Salt	Negative Correlation	Negative Correlation	Positive Correlation

Table 4.4 The correlation between the nutritional contents of retailer's own brand strawberry yogurt products and the cost of these products.

The only result of no correlation between the price and fibre value of the strawberry yogurt was the SuperValu own brand yogurts, In Figure 3.14, the fibre value of the SuperValu product did not change as the price increases, therefore there was no correlation. The results of this analysis are inconclusive due to the fact that there were only two data points. Therefore, as with the case of the Fibre in the SuperValu products, the only way that there would be no correlation was if the nutritional content remained the same in both products. However, the data is still relevant as it demonstrates what nutrient went up in the premium products, and what nutrients reduced. The Tesco premium product had a reduction in energy, fat, saturated fat, sugar, carbohydrates, protein and salt from the core product. Taken together with the analysis of the ingredient declaration of the Tesco products, these findings implicate that the premium product from this retailer was more beneficial due to the lower saturated fat and sugar content in the premium product than the core.

The product analysed from the top shelf was chocolate cookies. The products selected from Dunnes Stores were Dunnes Stores Chocolate Chip Cookies 200g, Dunnes Stores Chocolate Chunk Cookies 225g and Dunnes Stores Simply Better Handmade Belgian Triple Chocolate Cookies 185g. Upon analysis of these products, it was established that the Dunnes Store premium product was the least problematic for the consumer, while the core tier was the worst product in terms of nutritional contents. The premium product has a much more natural ingredient declaration while the core cookies were highest in saturated fats and was the only product not produced with fortified flour.

The products selected from Tesco for this top shelf of the food pyramid was Tesco Chocolate Chip Cookies 250g, Tesco Chunky Chocolate 10 Cookies 200g and Tesco Finest Quadruple Chocolate Cookies 200g. In this retailers' offerings, it was found that the value tier was the least problematic here in comparison to the premium product that was most problematic. The premium tier had the highest amount of sugars while the value product contained lower sugar, saturated fat and salt than the other two tiers. The value product also had less food additives.

The SuperValu cookie products analysed were SuperValu Chocolate Chip Cookies 225g, SuperValu Fully Chocolate Coated Cookies 175g and Signature Tastes All Butter Belgian Triple Chocolate Chunk Cookies 200g. Upon analysis it was found that the premium product was the least problematic in the SuperValu range, with the core product being least beneficial to the consume, the same as found in Dunnes Stores. The value and core cookies

from SuperValu contained glucose-fructose syrup which taken together with the findings from Patterson *et al*, 2018, that glucose-fructose syrup has been linked as a source of high calories in children, and the development of diabetes type 2, these findings implicate that the SuperValu value and core cookies, despite having lower sugar value than the premium product, would be least beneficial to the consumer. Upon analysis of the three retailers across the value tier products, it was found that the Dunnes Stores product was the least nutritionally problematic for a consumer, with the SuperValu product ranked as the most problematic. The Dunnes Stores product was also the cheapest product, while the SuperValu product was most expensive. Upon analysis of the three retailers across the core tier products, it was also found that the Dunnes Stores product was the least nutritionally problematic for a consumer, with the SuperValu product ranked as the most problematic. The Dunnes Stores product was also the cheapest product, while the Tesco product was the most expensive here.

Upon analysis of the three retailers across the premium tier products, it was found again that the Dunnes Stores product was the least nutritionally problematic for a consumer, with the SuperValu product ranked as the most problematic. Additionally, the Dunnes Stores product was the most expensive product, while the Tesco product was the cheapest on this tier. When analysing the mean tier values in compared to the branded product analysed, it was found that the branded product was the best choice in terms of nutrition, with the premium tier being the second best, and the core tier being the worst option for the consumer.

In terms of the statistical analysis, it was found that the only statistically significant difference was between the value and core tier in terms of carbohydrates. The value tier had a mean carbohydrate value of 61g per 100g of product while the core tier had a mean carbohydrate value of 59.2g per 100g. Upon analysis of this, the sugar content of 32.17g in the value tier and 36.17g in the core tier, it is possible to postulate that the value tier, in terms of statistical significance, has more complex carbohydrates than the core tier. The results of this analysis were very skewed, with p values ranging from $p=0.02$ to $p=0.99$ as outlined in Table 4.5.

Chocolate Cookies P values			
Nutrient	Value vs Core	Core vs Premium	Value vs Premium
Energy	p=0.11	p=0.44	p=0.81
Fat	p=0.06	p=0.51	p=0.38
Saturated Fat	p=0.08	p=0.73	p=0.06
Carbohydrates	p=0.02	p=0.93	p=0.06
Sugars	p=0.45	p=0.80	p=0.45
Fibre	p=0.71	p=0.26	p=0.11
Protein	p=0.26	p=0.24	p=0.99
Salt	p=0.31	p=0.10	p=0.23

Table 4.5 The p-values calculated upon analysis of retailer’s own brand chocolate cookie products. Products were compared by a tier basis.

The correlation between the nutrients per tier and the cost of each product was also analysed, the results of which are outlined in Table 4.6

Chocolate Cookies Correlation			
Nutrient	Dunnes Stores	Tesco	SuperValu
Energy	No Correlation	Positive Correlation	No Correlation
Fat	No Correlation	Positive Correlation	No Correlation
Saturated Fat	No Correlation	Positive Correlation	No Correlation
Carbohydrates	No Correlation	Negative Correlation	No Correlation
Sugars	No Correlation	Positive Correlation	No Correlation
Fibre	Negative Correlation	No Correlation	Negative Correlation
Protein	No Correlation	Positive Correlation	No Correlation
Salt	No Correlation	No Correlation	Negative Correlation

Table 4.6 The correlation between the nutritional contents of retailer’s own brand chocolate cookies products and the cost of these products.

There was very little correlation found between price and nutritional content of the retailer's own brand cookie products. The Tesco products had a positive correlation for the energy values, fat, saturated fat, sugar and protein values, meaning these values increased with the price. This supports the analysis results of the Tesco own brand products, in that the value product was more beneficial than the premium product. Both Dunnes Stores had no positive correlation between price and nutritional contents in their products. The nutrition fluctuated between each tier in terms of energy, fat, saturated fat, sugars and protein.

Overall, based on the statistical analysis, the difference between the three tiers across the three main retailers in Ireland are not statistically significant. The exception to this is the carbohydrate content between the value and core own brand products in the cookie and wholemeal bread products. The strawberry yogurt products reviewed had smaller amounts of carbohydrate content, and so no statistical difference was found for these products. The value tier products were shown to have a higher carbohydrate content than the core products. This supports the review that carbohydrates have been established to have a low-cost value for food manufacturers. Therefore, if more carbohydrates are added to the value products, these then become cheaper, allowing for these cheaper prices. However, given the sugar value in these products showed no statistical difference, it can be postulated that the value products were higher in complex carbohydrates, which have been established as more beneficial for consumers due to the slow energy release mechanism.

There is also some evidence in the correlation between the cost of retail own brand products and the nutritional content to suggest that more data is needed in order to establish if there is a significant difference. On analysis of each individual product in terms of nutrition and ingredient declaration, the premium tier products were selected more often as the most beneficial across all three products, with the value tier having one most nutritionally beneficial outlier in the Tesco value cookies. The Value tier and premium tier were equally selected as the least beneficial tiers throughout this analysis, across all products analysed. It is possible to extend these finding further to suggest that the core products are more likely to be the middle ground product, while the nutritional variance is between the value and premium products.

Chapter 5

Conclusion and Future Work

5.1 Conclusion

In conclusion, this analysis of retail own brand products in term of nutritional content and cost is important given the dietary challenges facing the general consumer in Ireland and the strain that this is placing on the health service. While consumers have never been more educated in nutrition and the importance of a balanced diet, as a society, we are more susceptible to dietary related disease than ever before. The demand for global foods to be delivered to local retailers at a high quality and low price has created an incentive for food manufacturers to use food additives such as preservatives and stabilisers in order to meet this demand. Review have found that synthetic food additives have been recognised to cause negative implications to hormone levels and obesity upon consistent consumption. Therefore, it is imperative that these additives are taken into consideration when evaluating the nutritive content of food. The current product offering is vast and deciding what product is nutritionally more beneficial can be challenging. The three-tiered structure of marketing own brand goods gives certain connotations to consumers about the contents of these products based on price. However, after close analysis of the three categories of retail own brand products, findings based on statistical analysis have established that there is no significant difference in the nutritional content between the three tiers across the three main retailers in Ireland. The exception to this is the carbohydrate content between the value and core own brand products. The value tier products were shown to have a statistically significant higher carbohydrate content than the core products. However, there is also some evidence in the correlation between the cost of retail own brand products and the nutritional content to suggest that if the scope of the research was expanded to collect data from a wider array of products, then a statistical difference of significance may be established.

In addition to this, the review of each individual product in terms of nutrition and ingredient declaration has found that the premium tier products were selected more often as the most beneficial across all three products, with the value tier having only one most nutritionally beneficial outlier in the Tesco value cookies. This supports the findings of O'Donnell *et al*, 2020, that the lower income social class is more at risk of obesity and dietary related illness. Additionally, the value tier and premium tier products were equally selected as the least beneficial tiers throughout this analysis, across all products analysed. This therefore suggests that, there is variance is between the ingredient and nutritional content of the value and premium products.

5.2 Future Work

It is important to assess the nutritional differences between cheaper and more expensive products as the obesity levels in Ireland are placing a strain on the health service. With life expectancy increasing, dietary related diseases have become one of the biggest challenges for the health service to tackle. While the government of Ireland have established organisations such as Healthy Ireland and the Sláintecare programme to combat this crisis, it still remains to be an important issue. It could be recommended, considering consumers are now more educated than ever, that the focus of the government should be on food manufacturing rather than the use of the product by the end consumer. While the food reformulation strategy seeks to do this, it is not yet legislation and will present many challenges to food business operators. It could be suggested that products, regardless of whether they are marketed as a value, core or premium product, must have nutritional limits set as per tiers of the food pyramid. However, if it is established that the more expensive products are those that are most beneficial in terms of nutrition, the potential for the reformulation of products to drive up food costs for consumers must be considered.

It would be recommended for retailers that given the potential for the food reformulation to become legislation, that they begin to evaluate their own brand product lines, regardless of what tier the products are established as, and highlight the most important areas to begin reformulation. Consumers are now more educated in the importance of a balanced diet than ever before, and in addition to having easy access to information regarding the nutritional content of their food, as well as the ingredient content, consumer demand for reformulated products could potentially become an important trend.

Overall, given the novelty of this research, it would be recommended that this analysis should be repeated on a broader scope with a larger product base. As findings have established that there is a statistical significance between the carbohydrate levels in value tier products and core tier products, it is recommended to focus further analysis on these product parameters.

Chapter 6

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