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**Health Claims on the Consumers' Acceptability,
Emotional Responses and Purchase Intent
of Protein Bars**

A Dissertation
submitted in partial fulfilment
of the requirements for the Degree of
Master of Science in Food Innovation

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by
Mishika Thakur

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Consumers are becoming more aware about their health and are concerned of what they are consuming, ultimately leading them towards healthy food choices. In context to healthy food choices, health claim labels on the food items are becoming more important in helping consumers in terms of providing information which helps in their purchase intentions. The main objective of this research was to study the effect of health claims on snack (protein) bars on consumer's acceptability, emotional responses and purchase decisions. For this study, four protein bars were selected by a focus group (N=4) based on acceptability. A total of N=80 participants evaluated the four pre-selected protein bars in two different tasting sessions [(1) Blind, where no information was provided and (2) Informed, where information related to health claims associated with the same protein bars were provided]. Participants were asked to rate their liking for different sensory attributes (Taste, Texture, Appearance, Aroma, Sweetness, Bitterness, Aftertaste and Overall Liking) in context with four types of protein bars in two sessions using 9-point hedonic scale. Also, CATA was used to study the emotions and sensory attributes experienced by the consumers in the blind and informed conditions. Purchase intent of consumers for both sessions was also analysed. In general, taste overpowered the health claims and there was no significant difference between the acceptability of samples in the two sessions.

Purchase intention was found to be high for the samples that were associated with positive emotions. For instance, highest purchase intent was for the Cranberry and Raspberry protein bar which was associated with emotions such as "comforting", "happy", "good", "pleasant" and others. There was some marginal difference between the purchase intent of protein bars when the health claim information was provided. There was non-significant increase in the purchase intent by 6%, 3% and 4% for the samples CDC¹, CR and SC respectively when the information was given. However, there was

¹ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
CR-Cranberry and Raspberry
CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

no significant change in the emotions and purchase intent of consumers when they were provided with health-related claims. Overall, this study showed that health claims did not have significant impact on consumers' acceptability, change in emotions and purchase intention in case of protein bars.

Keywords: Health Claims, Protein Bars, Sensory Liking/Acceptance, Consumer Emotions, Purchase Intent.

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Chapter 1

Introduction

Health and food are like two sides of a single coin that cannot be parted. In order to maintain good health, a balanced diet is needed. Consumption of food in excess may lead to diseases. For instance, processed food mainly include high levels of sugar, salt and fat which if consumed in higher amount may lead to obesity, diabetes, and cardiovascular disease (Stuckler & Nestle, 2012). According to World Health Organization (WHO), ingestion of gluten has resulted in an autoimmune disease named Coeliac disease in 1% of the genetically weak population (WHO, 2015). If left untreated or undiagnosed, it may result in addition of severe other health issues like iron deficiency anaemia, lactose intolerance, nervous system disorders and many more (WHO, 2015). However, the only current treatment for this disease is strict gluten-free diet (Green & Jafri, 2003; Who, 2015). Similarly, intake of sugar in an improper or excess amount is dangerous as it may lead to various changes in the body. Some of the changes are similar to the symptoms and abnormalities observed in case of maturity-onset diabetes and also in cases of coronary heart disease (Yudkin, 1987). According to Yudkin (1987), high intake of sugar may also lead to severe damage to the kidney. Another example could be high intake of fat diet which is also harmful and has been reported to contribute to obesity epidemic. It has been observed that intake of high fat diet results in some alterations in the body (elevation in *Firmicutes* and reduction in *Bacteroidetes*) that have been associated with obesity and ultimately development of chronic diseases such as Diabetes, Cardiovascular disease, Central Nervous system disorder and others (Murphy, Velazquez & Herbert, 2015). In addition, less than optimum level of some nutrients may also be harmful to the human health. It has been reported that deficiency of protein leads to loss of muscle mass which results in bone-related diseases. Nevertheless, intake of diets high in protein can help in decreasing the bone loss and it has also been reported to reduce the risk of fractures (Rizzoli et al., 2018). Therefore, it becomes crucial for consumers to maintain a balanced and healthy diet in which some external information such as nutritional or health claims, present on the packaging of food may be very helpful for them in their purchase intention.

In the food market, there are a several healthy food options available for consumers even for their specific needs such as gluten-free foods, high-protein food and others. According to Hasler (2002), consumers are becoming more and more aware about their health and food choices as they believe that consuming healthy food options is a better way to manage any health issue as compared to having medicines. Among consumers, preference or liking for a product varies on a large scale (Cho, Chung,

Kim & Kim, 2005). It may depend on the age and culture of the consumers (Kim, Lee, Kwak & Kang, 2013). Also, it depends on other several factors like taste and appearance of the product, cost, emotions, and health benefits (Napolitano et al., 2009). Therefore, such factors along with claims related to nutrition and health on food products may help consumers make better and healthier food choices. It is also possible that claims may have a 'halo' effect or induction of positive emotions that may result in influencing consumer perceptions of foods and enhancing the food consumption (Benson et al., 2018). One of the best marketing strategies of food companies is to produce different products that enhance the positive emotions in consumers in order to increase the overall liking (Schouteten et al., 2018). Hence, health claims information is important for the consumers as well as food industries.

1.1 Types of attributes related to foods

Sensory evaluation is directly proportional to its expectation about the taste of the foods (Schifferstein et al., 1999). It is often assumed that the post-consumption evaluations of food with a health-related claim can be perceived differentially—perhaps more favourable than those without such claims mainly due to the growing interest of consumers as well as marketers in healthy foods (Wansink et al., 2005). From a marketing perspective, it is very important to be aware of the extent to which health claim is crucial for the selection of functional foods (Monaco, Ollila & Tuorilla, 2005). Food-related attributes can be categorised into three types, i.e., search or extrinsic attributes, experience attributes, and credence/intrinsic attributes. Search attributes can be analysed just by looking, smelling or searching the product before consumption and even before purchase (such as price or colour). The second type are the experience attributes, as the name suggests they can be experienced after the food is consumed; for example, flavour or taste attributes. Some other attributes cannot be accurately evaluated before consumption and hence they are considered a part of the credence category (Wansik, Van & Painter, 2004; Consumer Affairs Victoria, 2010). Credence attributes are associated with the characteristics that cannot be evaluated by consumers even after its consumption (Consumer Affairs Victoria, 2010). Compared to other types, credence attributes are difficult to determine without the help of an expert or empirical data related to the particular sample used for evaluation as their true value is difficult to be verified by average consumers. Examples of credence attributes include healthiness, safety, and naturalness, which are considered crucial for food choices (Heuval et al., 2007). Different level of impact of health labels can be expected for different type of attribute. The effect of labels on the evaluation of search attributes is expected to be the smallest. Consumers can determine product's actual level of impact in terms of colour or price just by looking at the product and will not be influenced that much by the labels related to health—as the colour green will remain green no matter what health claims the product has (Wansik, Van & Painter, 2004).

According to Wansik, Van & Painter (2004), the massive and highest impact of health labels and diet labels is on the experience attributes, such as satiation and taste. However, consumers may build expectations before consumption of food and these expectations may result in biasness of their perception. In case of credence attribute, consumers are not able to evaluate the true level of such attributes hence there are higher chances to be more dependent on the information provided in the form of labels; for example, health claims (Wansik, Van & Painter, 2004).

1.2 Regulatory Bodies and Health Claims

Most of the time, nutritional claims and health claims are treated as the same information; however, they both have different definitions. As per the Food Standards Australia New Zealand (FSANZ), nutritional claims refer to the information of certain nutrients or substances present in that particular food (FSANZ, 2016). Such claims need to meet the standard requirements set by the authority. According to FSANZ, health claims can be defined as the relationship between food and health. FSANZ states, there are two types of health claims named General level health claims and High level health claims. General level health claims refer to a substance or nutrient present in a food or the food itself and its health related effects. They are not associated with any type of severe disease. On the other hand, high level health claims refers to a substance or nutrient in food and its relationship with any severe disease. Both type of health claims need to base their claims from the pre-approved food-health relationship (FSANZ, 2016). According to the European Commission (EC), a nutrition claim can be defined as any claim related to food products which states, advices or implies that a food has beneficial nutritional properties mainly because of the energy it gives but it does not provide the information about the nutrients or other substances it may comprise of or not (EC, 2006). On the other hand, a health claim can be defined as any message conveyed in the form of image or text that advices, states or implies that there is a relationship between food and health or one of its component has health benefits (EC, 2006). Together, both terms are referred to as Nutrition and Health Claims (NHCs) and its main motive is to inform food purchasing and consumption decisions, and this, in turn, may aid consumers in maintaining a healthy as well as balanced diet (Lähteenmäki, 2013). In the year 2006, the European Commission (EC) introduced a new regulation (EC 1924/2006) on nutrition and health claims related to food (EC 2006) in order to ensure a high level of protection to consumers and to harmonise the rules governing the use of nutrition and health claims on foods and drinks throughout the European Union (EU). As per the studies done in the past, health claims on the food products are mainly associated with the consumers who may have some issues related to the digestive system, cardiovascular system or cholesterol (Kaur et al., 2016; Lalor et al., 2010).

1.3 Insight of Health Claims

Previously, consumers were found to have a positive biasness towards health claims as compared to the ones without any such kind of information (Balasubramanian & Cole, 2002). The perceived positive biasness was observed in terms of purchase intent, willingness to pay, elevated consumption, enhanced perceptions of appropriate serving size and reduced calorie estimation (Dixon et al., 2011; Dixon et al., 2014; Hwang, Lee & Lin, 2016). However, there are some studies that showed no difference between health claim and no claim conditions in terms of perceived healthiness, purchase intentions and overall attitude of consumers towards the food product (Keller et al., 1997; Maubach, Hoek & Mather, 2014). According to Nocella & Kennedy (2012), health claims are cumbersome to read and difficult to be understood by the consumers. Moreover, Chrysochou & Grunert (2014) reported that the use of pictures rather than text for depicting healthfulness is more favourable from consumer's perspective. In some cases, health related information have been reported to have negative sensory as well as hedonic expectations. If the consumer is not satisfied with the product consumed it may result in negative response towards the food item. Personal disposition (pessimist or optimist) plays an important role in influencing the satisfaction of a person for the food that is consumed. In case of favourable and successful outcomes related to a food item, positive response is a general expectation, failing to which leads to disliking of that product and ultimately negative health claim expectation (Kahkonen & Tuorilla 1994; Tuorilla et al., 1994). In order to have a positive impact for health or diet labels, one of two conditions needs to be achieved, either there should be a diminished expectation towards the food (due to the label) or there should be a very optimist disconfirmation of the consumer's expectations (Wansik, Van, & Painter 2004). This means that the food has to taste much better as compared to what is expected. In some past studies, foods have failed to overcome poor prior expectations. When this happens, the post-consumption evaluation is simply assimilated with negative expectations and the resulting evaluation is comparatively less preferred. (Wansik, Van, & Painter 2004).

In the last few years, researchers have become more interested in analysing the influence of NHR claims on consumers. One model associated with the processing of information provided is the elaboration of the likelihood model abbreviated as ELM. It relies on the fact that every human is different and everyone has different levels of ability and motivation towards the understanding of the information provided. This approach led to two consumers characteristics, i.e., nutrition knowledge and health motivation (Steinhauser & Hamm 2018). This may lead to an important question that what sort of data and evidence about consumers understanding are enough in order to show that the average consumer can be expected to understand a particular nutrition and health claim (Leathwood et al., 2007).

1.4 Snack/Protein Bars: Healthy food choice

Snack bars are a food category that grows worldwide at an average of 2% every year (Nielsen, 2016 as cited in Pinto et al., 2017). In Brazil, the average growth of this category from the year 2013 to 2014 was 7.5% in volume (Souza, 2014 as cited in Pinto et al., 2017). The snack bar market of Asia-Pacific has been forecasted to grow at a CAGR of 4.9% during the years 2019-2024 (Mordor Intelligence, n.d.). Moreover, the market revenue of Australia for this food category was estimated to be 575.2 USD million for the year 2018 and is expected to increase by almost 25% by the year 2024. Its demand has augmented in countries such as Australia, China, India and Japan mainly due to the increasing awareness on health issues and hence making healthy food choices (Mordor Intelligence, n.d.). Consumers are demanding naturally-sourced, healthy and nutritious food products, which in turn is boosting the demand for snack bars among consumers. According to studies, Australian consumers spend more on healthy and convenience snack products mainly because of changing lifestyles, and increasing dietary intake. The trend of “Anytime” snacks is increasing in countries such as Australia and snack bars are used as meal replacement by consumers that are health-conscious (Mordor Intelligence, n.d.). As per Palazzolo (2003), the catalyst for the growth of this category (snack bars), from the last few years, is mainly because of the food items with the main focus on convenience and health. Brazil has surpassed the United Kingdom and Germany in terms of healthy food segment as it has grown up to 98% and is considered to be the fourth largest market for healthy products since the year 2014 (Datamark, 2015). Snack bars are of various types, made of the combination or blend of variety of healthy food products, also known as superfoods such as soy, oats, sesame, brown rice, flaxseed, lentils, nuts, pumpkin seeds, and quinoa. The blend of these bioactive elements either have higher or lower sensory acceptability among consumers depending on the combinations of these different superfoods (Aliani et al., 2011; Aramouni & Abu-Ghoush, 2011; Ryland et al., 2010; Suheim et al., 2015). The snack bar industry is highly versatile comprising of huge variety of bars (cereal bar, protein bar, fruit bar, Energy bar, Seed bar), in the most diverse intrinsic and extrinsic attributes (Pinto et al., 2019). Out of all, energy bars and protein bars are gaining more popularity as compared to other types due to the high content of protein present in them (Mordor Intelligence, n.d.).

Protein bars are one of the modified types of snack bars which were first introduced in the food market in 1990s. The main focus in the manufacturing of protein bars is the use of the maximum amount of ingredients possible that are high in protein. There is a wide diversity of protein bars that mainly depends on the intention of functionality. For example, improving LDL-cholesterol levels, benefitting heart health and strengthening muscles (Zhu & Labuza, 2010). Commercially produced protein bars mainly comprise of 20-40% proteins, 10-50% carbohydrates and 10-15% of fat with a water activity (a_w) ranging between 0.50 - 0.65. The composition of these nutrients may define the texture and taste

of the protein bars (Imtiaz et al., 2012; Zhu & Labuza, 2010). With the food industry becoming more experimental in terms of food innovation, food technologists are making and are expected to make protein bars with more uncommon ingredients. For instance, it is expected that in the coming future, food industries may also include vegetables in the protein bars in order to increase market sales (Bamford, 2016).

According to one of the reports of Euromonitor (2013), despite the fact that traditional diets have a huge diversity across continents, consumer's taste towards snack products or bars has been noticed to be more universal but with some modifications to the product as per the area where these food items are being sold. This gives manufacturers an opportunity to build global labels and products. However, in order to be successful, the main key is customization depending on the local consumers having the product (Euromonitor, 2013). Some snack bars are not considered to be functional food because they include nutrient-poor products; however, research has been done to introduce new varieties and bioactive components, with the potential of being healthy for consumers. Consumption of most of the snack bars comprising of healthy ingredients is considered healthy and may lead to weight loss or aid in weight management. Many past studies have proved efficient weight loss in people if they substitute their meal with cereal bars (Heber, Ashley, Wang, & Elashoff, 1994; Noakes, Foster, Keogh, & Clifton, 2004; Sung et al., 2014). As protein bars are considered healthy food choice by the consumers who believe in the importance of good health, research in the past has been done focussing on the area related to different criteria which offer low energy density, satiety or even low glycemic response (Gutkoski, Bonamigo, Teixeira & Pedó, 2007; Lobato et al., 2012).

1.5 Influence of Health Claims on Consumer' Acceptability

In order to evaluate the impact of health claims on consumers, several studies with various food products had been done in the past. Some used more favourable food products (having average taste ratings well above the mid-point of the ratings scale), on the other hand, relatively less favourable food items (having average ratings well below the midpoint of the rating scale) were used. The overall crux of such studies were that the effect of health claims cannot be standardised as it may depend on cornucopia of factors such as type of food product, region of sale, familiarity of food product, target consumers and many more (Wansik, Van & Painter, 2004). One factor is familiarity towards food item and also towards the health related information. Some studies used unfamiliar food products whereas others used familiar foods products with regards to the consumers which revealed that familiarity plays an important role as health claims associated with familiar food products had more impact on consumers as compared to unfamiliar food items (Cardello et al., 1985; Tuorila et al., 1994b). Some of the examples of food products are desserts, snack bars, yoghurt, lasagne, entrées, side dishes

etc. (Oakes & Slotterback, 2000; Wansik, Van & Painter, 2004; Pinto et al., 2017; Pinto et al., 2019; Yan et al., 2015). Protein bars are likely to be perceived as a nutritious and healthy food choice; therefore, using such food option may complicate the empirically analysis of the difference between health related information that is provided and not provided to the food product (Kahkonen et al., 1997; Vickers, 2000; Wansik & Park, 2002)

Recently, Yan et al (2015) conducted an experiment where comparison of effects of branding, ingredients, and nutrition information on consumer liking was evaluated. They confirmed that branding and health-related information has the potential to improve consumer acceptance towards any food product (Yan et al., 2015). Pinto et al (2017) found a positive influence of health claims on the snack bars acceptance in Brazilian consumers. In the year 2018, a survey was conducted across the island of Ireland where participants were presented with three different types of claims associated with four kinds of food items, i.e., cereal, soup, lasagne and yoghurt. It was hypothesised that claims had little impact on taste, portion size, and healthiness. However, psychological factors, for instance, familiarity of consumers with the food and their beliefs in the claim has been the most consistent predictor of perception (Benson et al., 2018). Another study was conducted in 2018 using six Brazilian commercial brands of snack bars which proved that when consumers were delivered the information about health claims associated with snack bars, it positively influenced the sensory acceptance of consumers as compared to the blind test where no such information was shared (Pinto et al., 2019).

However, some studies as mentioned below oppose the above-mentioned experiments stating that health claims do not have any effect on consumers. It has been reported that consumers may say that health claims are helpful for them but to what extent they utilize these claims is yet not clear. Health claims, on their own, may not have a significant impact on the consumption behaviour of consumers may be due to their lack of trust or interest in the claims (Williams, 2006). According to one of the reports made by Health Canada in the year 2000, consumers lack the knowledge of nutrition and hence it hinders with their ability to evaluate health claims which ultimately deteriorates the credibility of claims (Health Canada, 2000 as cited in Williams, 2006). As per Van et al (1996), there is a theoretical model associated with the impact of health claims, i.e., the Attitude-Social-Influence-Self-efficacy (ASE) model. Depending on this model, there are numerous steps to be followed for any health claim to have an impact on the behaviour of consumer's food choice. These steps include exposure and attentiveness towards claim, clear apprehension of the claims, alteration in the attitude and belief (trust) and behavioural change maintenance. It has been advised that the greatest impact of claims is mainly on the consumers who already tend to purchase any particular food item. There are very fewer chances of people buying a new type of item just because of the health claims on it

(National Institute of Nutrition, 1999 as cited in Williams, 2006). It has also been noticed, in most of the cases, the usage of health claims is greater by people who are better educated and have an interest in nutritional knowledge. Also, females and elderly people tend to use health claims much more than the rest of the population (Fullmer, Geigher & Parent, 1991; Bhaskaran & Hardley, 2002).

1.6 Consumer Evaluation

Different studies related to food products in the area of sensory science demand different type of sensory tests such as consumer's oriented tests (affective) and product oriented tests (analytical) depending on the main purpose of the study (Watts et al., 1989). Consumer tests involve the response of consumers so that there will be a better knowledge of what exactly consumer demands from food companies. There are different consumer tests such as check all that apply (CATA), hedonic (degree of liking), triangle test and others. In order to study the effect of any sort of labels on consumers, CATA and hedonic point are most suitable. CATA measures sensory attributes perceived by the consumers which helps in determining the characteristics of a particular product. The questions in CATA are designed in such a way that it permit consumers to select all the potential attributes from the list provided to describe the product (Dooley, Lee & Meullenet, 2009). CATA is easy to be used by the consumers as no training is required and gives detailed, discriminative, and trustworthy results. However, it does not tell about the intensity to which any particular attribute is perceived (Jaeger et al., 2018 as cited in Gunaratne et al., 2019; Dooley, Lee & Meullenet, 2009). In case of hedonic scale, consumer has to tell the degree of liking they perceived with respect to the attributes provided for a specific product. It can measure the acceptability of consumers depending on the intensity of how much the product is liked by people depending on the presence of various attributes. Hedonic scale is of different types such as the 3-point hedonic scale, 5-point hedonic scale, 7-point hedonic scale and 9-point hedonic scale. Out of all, the most common and most used in the consumer tests is 9-point hedonic scale as it provides a wide range to select from. (Torre, Rodas, Badolato & Tadini, 2003; Watts et al., 1989). Once the data from such tests is collected, it is analysed statistically and evaluated in regards to the study undertaken. These tests have several applications in the food industry such as it gives an idea about the buying intention of consumers. Basically, food is made for consumers and to have an insight of what consumers demand (through such consumer tests) helps in evaluating whether the product will be successful in the market or not, also it is helpful in new product development, product improvement, quality control, commercialization, prototyping and many more (Torre, Rodas, Badolato & Tadini, 2003; Suwonsichon, 2019).

Consumers and their acceptance for any food product differs depending on various factors. Providing them with some information on the packaging of food products such as health claims is important for

helping them choose healthy food options. Therefore, consumer tests should be conducted on regular basis to have an insight of what consumers demand and accordingly what food industries needs to upgrade.

1.7 Objectives

The aim of the present study was to evaluate the effects of health claims on the consumers' acceptance, emotions and purchase of protein bars. The main focus of this study was to analyse how consumers respond to any health related information given to them with respect to any healthy food product. Will there be any change in the liking of various sensory attributes, change in the emotions and change in the purchase intention between the two sessions i.e. Blind (Health claims not given) and Informed (Health claims given) in order to analyse how much importance does consumers give to such health claims.

The specific objectives of this research were:

- To evaluate the change in acceptability/liking of consumers for protein bars with and without the information provided related to health
- To analyse the change in emotions of participants while consuming protein bars in the two sessions i.e. with and without health claims information provided
- To assess the change in the purchase intention of consumers for protein bars with and without the information provided related to health claims

Chapter 2

Material and Method

2.1 Selection of samples

Initially, about 12 protein bars of different flavours were chosen and a focus group of four members were asked to taste each and every protein bar, which were segregated based on their liking, i.e., “Liked the most” and “Disliked the most”. Based on this segregation, two samples [Coconut and Goji Berry with Dark Chocolate (CGB) and Cranberry and Raspberry (CR)] were liked the most and two samples [Salted Caramel (SC) and Coconut and Real Dark Chocolate with Freeze Dried Raspberries (CDC)] were disliked the most by the focus group were selected for the study.

All the products were commercial and were bought from supermarket named Countdown situated in Lincoln, near Lincoln University, New Zealand.

2.2 Materials

The four different types of protein bar samples used are illustrated in Table 2.1. A sample tasting size of 1/4th part of each of the bar (approximately 8 grams) was placed in a plastic cup without lid and random 3-digit codes were allocated to them. The study included two sessions where first session had no information about the health claims and second session included health claim information with respect to the samples. Samples used in both the sessions were same but had different random 3-digit codes on the sample cup as participants were not aware that the samples in both the sessions were same. Two sets of samples were made and served one by one. Samples with their random 3-digit code IDs has been illustrated in Table 2.1. For palate cleansing in between the tasting the samples, water and unsalted crackers were also given.

Table 2.1: Ingredients involved in each protein bar sample (Source: Official website²)

Sample Name	Random IDs	Ingredients
Coconut and Goji berry with dark chocolate (CGB)	Session 1: 186 Session 2: 472	Sunflower Seeds (33%), Soy Protein Crisps (Soy Protein Isolate, Tapioca Starch, Soy Lecithin, Salt), Glucose Syrup, Dark Chocolate (10%) Sugar, Cocoa Mass, Cocoa Butter, Milk Fat, Emulsifier (Soy Lecithin), Natural Flavour), Chicory Fibre, Pumpkin Seeds (7%), Coconut (5%), Goji Berries (2%), Natural Flavours, Humectant (Glycerol), Food Acids (Citric Acid, Malic Acid), Emulsifier (Soy Lecithin), Sunflower Oil, Contains Traces of Peanuts and Tree Nuts. Dark Chocolate contains average 43% Cocoa Solids. Contains: Soy, Milk, Peanuts and Tree Nuts. May Contain: Cereals containing Gluten, Sesame Seeds and Sulphites.
Coconut and real dark chocolate with freeze dried raspberries (CDC)	Session 1: 264 Session 2: 801	Peanuts (33%), Soy Protein Crisps (Soy Protein Isolate, Tapioca Starch, Soy Lecithin, Salt), Dark Chocolate (10%), Sugar, Cocoa Mass, Cocoa Butter, Milk Fat, Emulsifiers (Soy Lecithin, 476)), Chicory Fibre, Maltodextrin, Coconut (4%), Glucose Syrup, Superseeds (6.5%) (Sunflower Seeds (3.5%), Pumpkin Seeds (2%), Chia Seeds (1%),0, Sunflower Oil, Glycerine, Freeze Dried Raspberries (0.7%), Natural Flavours, Soy Lecithin, Food Acid (Citric Acid), Caramelised Sugar Syrup. Contains Peanuts, Soy and Milk. Processed on equipment which also processes Cereals containing Gluten, Tree-nuts, Sesame Seeds and Sulphites.
Cranberry and Raspberry (CR)	Session 1: 583 Session 2: 761	Sunflower Seeds (44%), Glucose Syrup, Soy Protein Crisps (Soy Protein Isolate, Tapioca Starch, Soy Lecithin, Salt), Pumpkin Seeds (10%), Chicory Fibre, Dried Cranberry Pieces (7%) (Cranberries, Sugar, Sunflower Oil), Natural Flavours, Humectant (Glycerol), Food Acid (Citric Acid), Sunflower Oil, Emulsifier (Soy Lecithin), Salt. Contains Soy. May Contain: Cereals containing Gluten, Peanuts, Tree Nuts, Sesame Seeds and Sulphites.
Salted caramel (SC)	Session 1: 628 Session 2: 319	Peanuts (56%), Superseeds (10%) (Sunflower Seeds (7%), Pumpkin Seeds (2%), Chia Seeds (1%)), Glucose Syrup, Soy Protein Crisps (Soy Protein Isolate, Tapioca Starch, Soy Lecithin, Salt), Chicory Fibre, Sunflower Oil, Glycerine, Salt, Natural Flavour, Soy Lecithin, Caramelised Sugar Syrup, Stevia. Contains Soy and Peanuts. Processed on equipment which also processes Cereals containing Gluten, Tree Nuts, Milk, Sesame Seeds and ingredients containing Sulphites.

² All the protein bars used in the present study were from one brand i.e. Nice and Natural which is New Zealand based company headquartered in Auckland.



Figure 2.1: (A) Set 1 tray with samples (Session 1) (B) Set 2 tray with samples (Session 2)

2.3 Sensory Evaluation

Subject

For the experiment, a total of N=80 participants were recruited which included Lincoln University, New Zealand students and employees. Instructions were delivered and consent of the participants for experiment was obtained by asking them to sign the consent form. They also filled the form with general information about name, age, gender. Also, the frequency of consuming snack bars was asked. Out of 80 participants, 32 were males and 48 were females. The age of participants ranged between 20 to 59 years, out of which 77.5% consumers were less than 35 years of age. Out of 80 panellists, 63% of them agreed to consume snack bars frequently. The test took place in the sensory booths situated in the RHF building of Lincoln University, New Zealand. The tasting sessions took place on two days i.e. December 9, 2019 and December 10, 2019 under the controlled environment with room temperature 21°C and fluorescent lights. List of ingredients in the samples were also provided to the participants in order to ensure that they are not allergic to any of the ingredients involved in the protein bars used.

2.4 Sensory Procedure

Panellists were seated in the sensory booths individually and each booth was equipped with Samsung Tablet (Headquartered at Seoul, South Korea) on which the online questionnaire was asked to each participant. As mentioned, there were two sessions for the experiment i.e. Blind (B) and Informed (I). In the first session (B), participants were presented with four different types of protein bars (as shown in Figure 2.1). In the second session (I), participants were again presented with four different protein bars (as shown in Figure 2.2) but in this case, they were provided with some health related claims

associated with each and every sample. Table 2.2 represents the information given to the participants in the session 2 of the experiment. The health claim information was obtained from the packaging of commercial protein bars; however, it was not exactly same as represented in the Table 2.2 because some extra information was added for the better understanding of health claims among participants. Questions asked in both sessions were same with respect to the particular sample.

Participants were asked to taste the sample and evaluate their liking towards various sensory attributes with the use of 9-point hedonic scale. Participants also had to select all the attributes followed by the emotions on the basis of CATA that they perceived in the particular sample. Last but not the least, they were asked about the purchase intent i.e. whether they will buy that particular sample in future or not.

Responses of the participants were recorded using the RedJade software (RedJade Sensory Solutions, LLC located in Martinez, California). Participants were already provided with 2 links one for each session. By signing in to the first link, all the sample IDs appeared on screen one by one which the participant had to eat as per the order of each sample and evaluate on the basis of their liking on 9 point hedonic scale and also select all the attributes and emotions in the list provided they felt were present. In the last, purchase intent by simply answering to the question by Yes or No. After the completion of first session, participants were given few minutes break and then were provided with second set of samples. For which they were supposed to sign in to the second link provided and again repeat the whole procedure with second set of tray.

Table 2.2: Health Claims for samples presented in Session 2

The samples presented in front of you are protein bars with following health claims:

1. 20-25% protein per bar: Protein increases muscle mass and strength, provides energy, increases metabolism etc.
2. Contains 4 grams of sugar only: Less intake of sugar
3. Good source of fibre- Good for health
4. Contains super-seeds like pumpkin seeds, sunflower seeds: These seeds are good for **heart**, proved to reduce the risk of certain cancers. Pumpkin seeds are high in **anti-oxidants** and also improves prostate and bladder health. Sunflower seeds have **anti-inflammatory properties**, help to manage cholesterol, Rich in B-complex vitamin that is good for healthy **nervous system**
5. No artificial colour and flavours used

2.5 Experimental design and Statistical analysis

In order to assess the significant difference between the factors [Samples and Information provided (Blind and Informed)], a two-way analysis of variance (ANOVA) with a generalized linear model (GLM) was performed. For consumer liking of different samples, mean and standard error of the pooled data was calculated. For the multiple grouping within the sample and with respect to the condition, the Tukey test was performed. Moreover, for the presence of each attribute in the sample and emotion experienced using CATA questions and also the purchase intent were calculated using Cochran Q test (Sheskin test). Principal Component Analysis (PCA) was also performed. The PCA sample-attribute with respect to blind and informed condition plot was constructed based on the mean values of the sensory attributes. Also, Correspondence Analysis was obtained using the frequency data of attributes and emotions. Data analysis was done on two software packages: for two-way ANOVA, Minitab version 2018 (Headquarters: Pennsylvania, United States) and for the rest XLSTAT by Addinsoft (Headquarters: United States) was used.

Chapter 3

Results

Results:

The ANOVA results for the sensory liking depending on the effects including samples, condition and samples crossed by condition are summarized in the Table 3.1. The P-values for the liking of each attribute with respect to the effects (condition and sample) were evaluated. There were no significant differences in the attributes in regards to the condition alone and also in case of the interaction between condition and samples used, which means that health claims related to the samples had no significant effect on the participants' acceptability towards different sensory attributes. However, there is a significant difference between the samples in the liking of attribute terms aroma, taste or flavour, sweetness, bitterness, texture, aftertaste and overall liking among all the four samples used in the study.

Table 3.1: Two-way ANOVA* Table for the sensory parameters of protein bars

Effects*	Sensory Liking**							
	Appearance		Aroma		Taste or Flavour		Sweetness	
	F-value***	P-value	F-value***	P-value	F-value***	P-value	F-value***	P-value
Condition	0.47	0.49	1.24	0.26	0.35	0.55	1.20	0.27
Sample	1.89	0.13	4.31	0.00	6.07	0.00	4.08	0.00
Condition*Sample	0.19	0.90	0.43	0.73	0.27	0.87	0.52	0.67
Effects*	Bitterness		Texture		Aftertaste		Overall Liking	
	F-value***	P-value	F-value***	P-value	F-value***	P-value	F-value***	P-value
	F-value***	P-value	F-value***	P-value	F-value***	P-value	F-value***	P-value
Condition	0.08	0.77	0.91	0.34	0.91	0.34	0.89	0.34
Sample	4.16	0.00	12.69	0.00	4.28	0.00	6.22	0.00
Condition*Sample	0.10	0.96	0.38	0.76	0.16	0.92	0.54	0.65

*ANOVA = Analysis of Variance [4 samples i.e. protein bars (CGB, CDC,CR,SC), 2 conditions (Blind and Informed)]

** Sensory liking of different food stimuli was assessed with the use of 9 point hedonic scale (1= dislike extremely, 5= neither like nor dislike, 9= like extremely)

*** F-value= Mean square/Mean square error. Effects were considered significant when the probability $Pr > F$ was 0.05 (Bolded and italicised F-values and probabilities)

3.1 Sensory Attributes

Liking of Sensory Attributes

The calculated values of mean and standard error for all the attributes as per the liking of 80 participants without (Blind) and with (Informed) the health claim information has been illustrated in Table 3.2. Looking at the Table 3.2, it can be observed that there were some marginal differences in the liking of attributes between the samples and between the conditions provided (blind and informed); however the difference is not significant ($P \geq 0.05$). The first attribute was appearance, where sample CDC³ was the most liked whether the health claim information was provided or not, but liking decreased slightly in the informed case. For aroma, sample CR was liked the most in the blind condition. There was a non-significant ($P \geq 0.05$) decrease in the liking of aroma when the health claim information was provided for all the samples except for SC which had a non-significant ($P \geq 0.05$) increase in the liking of the informed case. However, there was a significant ($P < 0.05$) difference between the aroma of CR-blind and CDC-informed. In the case of first session when no health claim information was given, there was a significant difference ($P < 0.05$) in the liking of taste (or flavour) between the samples CDC and CR. The most liked sample with respect to taste or flavour and sweetness was CR in both conditions (blind and informed). The least liked sample considering the taste or flavour as well as sweetness was CDC (Blind); however, the liking increased marginally but non-significantly ($P \geq 0.05$) after the health claim information was provided. As such, there is no significant difference ($P \geq 0.05$) between the samples in taste or flavour and sweetness considering the condition of blind and informed. Liking towards bitterness of samples was maximum and minimum towards CR and CDC respectively in both conditions. There was a non-significant ($P \geq 0.05$) increase in the liking of bitterness in the case of CGB after the health claim information was delivered. The most liked texture by participants was of CGB when the health claim information was not given. When the information was given, texture of SC was the least liked among the participants. Moreover, there was a significant difference ($P < 0.05$) in the texture of CGB and SC samples when the health claim information was not provided (first session). Liking of aftertaste for all the four samples decreased non-significantly ($P \geq 0.05$) after the health claim information was given to the participants. Sample CR had the highest overall liking and the lowest liked was CDC despite its non-significant increase ($P \geq 0.05$) when the information of health claims was provided. There was a significant difference ($P < 0.05$) between the overall liking of CDC and CR as a sample itself but not with respect to the health claims delivered.

³ CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

Table 3.2: Mean & Standard Error values* of the sensory parameters of four protein bars in both the sessions**

Condition	Sample Name	Sensory Liking***							
		Appearance	Aroma	Taste or Flavour	Sweetness	Bitterness	Texture	Aftertaste	Overall Liking
Blind**	CGB ⁴	6.40 ± 0.16 ^A	6.50 ± 0.17 ^{AB}	6.37 ± 0.18 ^{AB}	6.52 ± 0.17 ^A	5.53 ± 0.16 ^A	6.62 ± 0.18 ^A	6.17 ± 0.20 ^A	6.61 ± 0.18 ^{AB}
	CDC	6.82 ± 0.16 ^A	6.17 ± 0.17 ^{AB}	5.87 ± 0.18 ^B	6.07 ± 0.17 ^A	5.22 ± 0.16 ^A	5.98 ± 0.18 ^{ABC}	5.43 ± 0.20 ^A	5.81 ± 0.18 ^B
	CR	6.47 ± 0.16 ^A	6.71 ± 0.17 ^A	6.73 ± 0.18 ^A	6.51 ± 0.17 ^A	5.78 ± 0.16 ^A	6.50 ± 0.18 ^{AB}	6.13 ± 0.20 ^A	6.65 ± 0.18 ^A
	SC	6.47 ± 0.16 ^A	6.36 ± 0.17 ^{AB}	6.15 ± 0.18 ^{AB}	5.87 ± 0.17 ^A	5.62 ± 0.16 ^A	5.78 ± 0.18 ^{BC}	6.03 ± 0.20 ^A	6.25 ± 0.18 ^{AB}
Informed*	CGB	6.45 ± 0.16 ^A	6.31 ± 0.17 ^{AB}	6.25 ± 0.18 ^{AB}	6.23 ± 0.17 ^A	5.61 ± 0.16 ^A	6.55 ± 0.18 ^{AB}	5.91 ± 0.20 ^A	6.40 ± 0.18 ^{AB}
	CDC	6.65 ± 0.16 ^A	5.88 ± 0.17 ^B	5.98 ± 0.18 ^{AB}	5.88 ± 0.17 ^A	5.13 ± 0.16 ^A	5.68 ± 0.18 ^C	5.42 ± 0.20 ^A	5.94 ± 0.18 ^{AB}
	CR	6.42 ± 0.16 ^A	6.56 ± 0.17 ^{AB}	6.60 ± 0.18 ^{AB}	6.31 ± 0.17 ^A	5.71 ± 0.16 ^A	6.57 ± 0.18 ^{AB}	6.06 ± 0.20 ^A	6.51 ± 0.18 ^{AB}
	SC	6.33 ± 0.16 ^A	6.45 ± 0.17 ^{AB}	5.98 ± 0.18 ^{AB}	6.00 ± 0.17 ^A	5.57 ± 0.16 ^A	5.58 ± 0.18 ^C	5.82 ± 0.20 ^A	5.95 ± 0.18 ^{AB}

*Mean and Standard Error values n=80 replicates (panellists), Mean values in the same column followed by different letters are significantly different (P <0.05)

** Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

*** Sensory liking of different food stimuli was assessed with the use of 9 point hedonic scale (1= dislike extremely, 5= neither like nor dislike, 9= like extremely)

⁴ CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

The Principal Coordinate Analysis (PCA) of the liking of sensory attributes in relation to the protein bars for both the sessions (Blind and Informed) is shown in Figure 3.1. Participants liked different sensory attributes of the different protein bars. Sample CR⁵ was associated with the sensory attribute terms like “taste”, “aroma”, “bitterness”, “aftertaste” and “overall liking”. Attribute terms related to the sample CGB were “sweetness” and “texture” and in case of CDC was “appearance”. However, samples with respect to their condition of health claim were seen in the same area of likeness towards different attributes. Therefore, there was no significant difference ($P \geq 0.05$) in the samples between the two sessions.

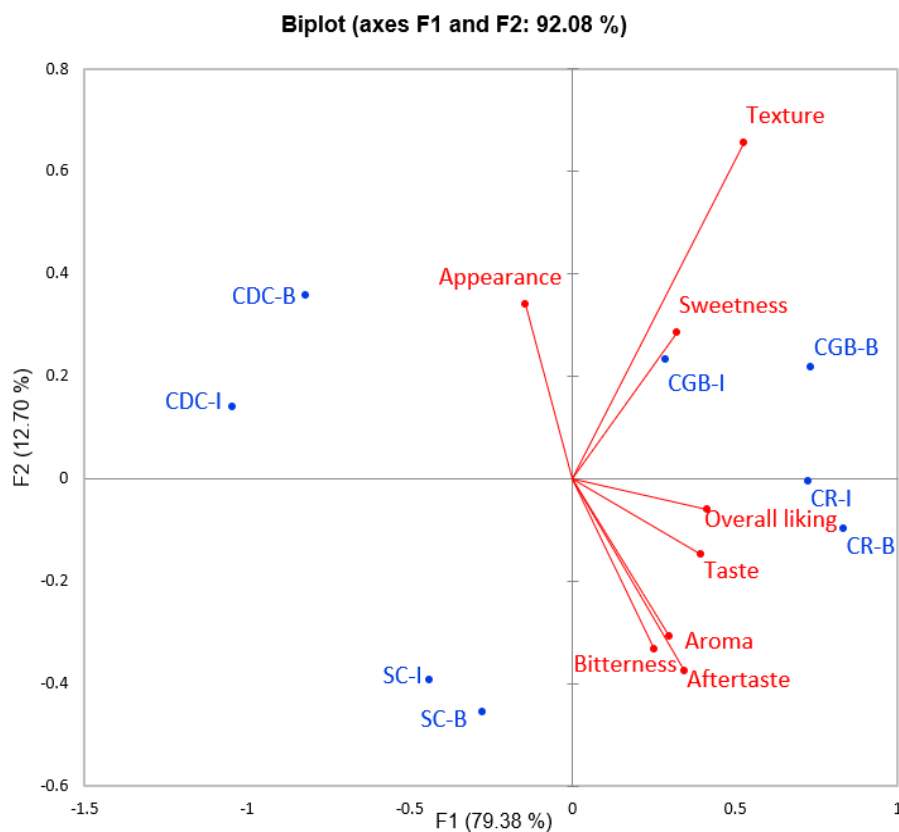


Figure 3.1: Principal Component Analysis(PCA) of sensory liking of attributes and four protein bars in both the sessions*

*Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

⁵ CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

Frequency of Sensory Attributes

The calculated frequency of each attribute experienced by all the candidate for four different samples before and after the information provided has been summarised in Table 3.3. Overall, there was no significant difference between the different attributes of samples as observed by participants with respect to the health claim information provided. There were some significant differences ($P < 0.05$) among the samples with respect to liking towards different attributes.

In the case of first session i.e. when no health claim information was delivered, there were some significant difference ($P < 0.05$) between the percentage of participants who tasted and experienced different sensory attributes among the four protein bar samples. For example, there was a significant difference ($P < 0.05$) between the percentage of participants who tasted sweetness, sourness, saltiness in the samples CGB⁶ and SC. Number of panellists who tasted bitterness in the sample CDC was significantly different ($P < 0.05$) from other three samples. Samples CGB and CR were significantly different ($P < 0.05$) from samples CDC and CR in the number of participants who experienced softness, brittleness and hardness. There was a significant difference ($P < 0.05$) in the number of participants who tasted flavours like dairy flavour, nutty flavour, chocolaty flavour and fruity flavour among all the four samples.

Also, there were non-significant changes observed related to the condition of blind and informed. Sweetness was tasted by most of the participants in the sample CR i.e. 57.5% which reduced by 5% when the health claim information was provided. Only 18.8% respondents tasted sweetness in the sample SC. About 16% participants experienced blandness in the sample SC-blind which decreased non-significantly ($P \geq 0.05$) by 10% once the information was provided. Sourness was observed by 25% of the observers in case of CR-blind and after the information was provided it came to 21.3%. Surprisingly, 2.5% participants identified bitterness in SC-B which increased non-significantly ($P \geq 0.05$) to 12.5% after the health claims were delivered. In case of each sample, percentage of participants who observed dryness decreased but non-significantly ($P \geq 0.05$) once the health claim information was provided. Umami was reported by 2.5% of participants in case of CR-blind which reduced to 0% after the information provided. In case of SC, percentage of respondents who experienced umami was increased non-significantly ($P \geq 0.05$) by 4% in case of informed session.

⁶ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
CR-Cranberry and Raspberry
CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

Another observation to be noticed was the non-significant ($P \geq 0.05$) increase in the participants who experienced softness in the sample CR⁷ in case of session 2. In case of blind, 45% of participants observed the softness whereas in case of informed, it elevated non-significantly ($P \geq 0.05$) to 62.5%. For almost every sample, number of participants increased (non-significantly i.e. $P \geq 0.05$) who observed chewiness and smoothness after the information was conveyed. Except for CGB, percentage of participants who experienced hardness increased non-significantly ($P \geq 0.05$) when the health claim information was delivered. Opposite to hardness, there was a non-significant ($P \geq 0.05$) decrease in the number of participants who observed stickiness once the information was given. Number of respondents who experienced chocolaty flavour in CR sample doubled after the health claim information was provided. Maximum number of participants tasted fruity flavour in the CR sample. The least number of participants tasted roasted flavour in the CR sample. After the information was provided, there was a non-significant ($P \geq 0.05$) increase of 5% of participants who tasted caramel flavour in the sample SC. After the health claim information was provided, for all the four samples, there was a non-significant ($P \geq 0.05$) decrease in the percentage of participants who experienced nutty flavour.

⁷ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
CR-Cranberry and Raspberry
CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

Table 3.3: Frequency* (%) of participants experiencing sensory attributes in four protein bars in both the sessions**

Sensory Attributes***	CGB ⁸		CDC		CR		SC	
	Blind	Informed	Blind	Informed	Blind	Informed	Blind	Informed
Sweet	55.0b	55.0b	37.5ab	36.3ab	57.5b	52.5b	18.8a	18.8a
Salty	13.8a	11.3a	17.5ab	17.5ab	11.3a	12.5a	37.5c	32.5bc
Bland	7.5ab	6.3ab	8.8ab	11.3ab	8.8ab	1.3a	16.3b	6.3ab
Sour	7.5a	11.3ab	10.0ab	6.3a	25.0c	21.3bc	1.3a	1.3a
Bitter	13.8ab	13.8ab	33.8c	21.3bc	8.8ab	12.5ab	2.5a	12.5ab
Dry	11.3ab	7.5ab	22.5ab	21.3ab	8.8ab	6.3a	23.8b	22.5ab
Umami	3.8a	2.5a	5.0a	2.5a	2.5a	0.0a	3.8a	7.5a
Creamy	12.5a	12.5a	1.3a	3.8a	7.5a	7.5a	7.5a	2.5a
Soft	43.8b	42.5b	7.5a	7.5a	45.0b	62.5b	5.0a	1.3a
Chewy	56.3c	56.3c	32.5ab	42.5abc	53.8bc	58.8c	27.5a	33.8ab
Smooth	16.3bc	17.5bc	6.3ab	6.3ab	18.8bc	26.3c	0.0a	1.3a
Brittle	13.8a	7.5a	33.8b	36.3b	3.8a	8.8a	37.5b	35.0b
Grainy	48.8a	50.0a	51.3a	38.8a	48.8a	46.3a	42.5a	43.8a
Hard	7.5a	3.8a	31.3b	43.8bc	1.3a	3.8a	65cd	73.8d
Sticky	31.3ab	38.8b	18.8a	12.5a	42.5b	40.0b	16.3a	15.0a
Off Flavour	10.0a	6.3a	13.8a	15.0a	7.5a	7.5a	10.0a	10.0a
Chocolaty Flavour	41.3b	43.8b	45.0b	46.3b	2.5a	5.0a	2.5a	3.8a
Dairy Flavour	13.8b	11.3ab	10.0ab	5.0ab	6.3ab	3.8ab	1.3a	6.3ab
Fruity Flavour	50.0cd	52.5de	23.8ab	31.3bc	73.8e	71.3de	3.8a	3.8a
Roasted Flavour	26.3ab	31.3abc	46.3bcd	48.8cd	23.8a	22.5a	60.0d	56.3d
Caramel Flavour	5.0a	5.0a	17.5ab	15.0ab	7.5a	5.0a	18.8ab	23.8b
Nutty Flavour	62.5abc	51.3ab	71.3bc	67.5abc	51.3ab	50.0a	73.8c	71.3bc

* Total percentage of participants experiencing particular attribute in the protein bar being tasted. Percentage in the same row followed by different letters are significantly different (P < 0.05)

** Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

*** Sensory attributes of different food stimuli was assessed with the use of CATA.

⁸ CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

The Correspondence Analysis showing the representation of protein bars in both the sessions in relation to the sensory attribute terms of the CATA question is presented in the Figure 3.2. CR-B⁹ and CR-I was associated with the sensory attribute terms “soft”, “sour”, “creamy”, “sticky” and “fruity flavour”. Protein bar SC in both sessions i.e. blind and informed was related to attribute terms “salty”, “hard”, “roasted flavour”, “caramel flavour”, “bland” and “grainy”. Sample CDC-B and CDC-I was linked to attribute terms “off-flavour”, “brittle”, “dry”, “umami” and “bitter” by the participants. Sample CGB was associated with attribute terms “sweet”, “chewy”, “dairy flavour” and “chocolaty flavour”. However, samples in response to the condition health claim i.e. blind and informed were seen in the same area of attributes observed by the participants. Therefore, there was no significant difference between the attributes of samples as perceived by participants when the information was provided.

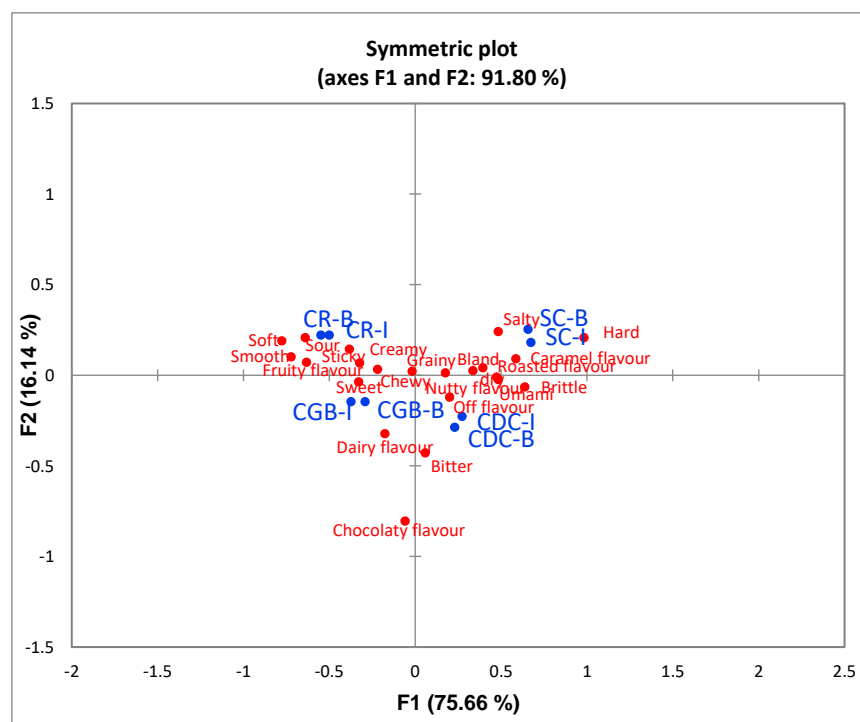


Figure 3.2: Correspondence Analysis of sensory attributes for each protein bar* in both the sessions**

*Four protein bars used

** Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

⁹ CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

3.2 Emotions

The calculated frequency of emotions perceived by the participants for four different samples before and after the information provided has been summarised in Table 3.4. There was no significant difference between the emotions experienced by the participants considering the condition of health claim information provided or not provided. There were some significant differences ($P < 0.05$) among the samples with respect to emotions experienced.

Number of panellists decreased significantly ($P < 0.05$) who associated emotion terms “pleasant” and “good” to the sample CDC¹⁰ as compared to the sample CGB. Also, there were some non-significant changes in the emotions observed related to the condition i.e. blind and informed. As compared to the blind condition, participants were happier when the health claim information was provided about the samples except for the sample CGB. Feeling of healthiness was experienced by 42.5% participants with respect to CR in the informed case. Number of participants reduced non-significantly ($P \geq 0.05$) who felt “calm” after tasting the samples CDC and CR when information of health claims was given whereas increased non-significantly ($P \geq 0.05$) in the case of other two samples i.e. CGB and SC. Percentage of participants who felt “satisfied” remained almost same in both the conditions for all the samples. The highest number of respondents who felt “good” after having the samples was 47.5% which was for sample CGB, condition blind. Very less number of participants felt “good” after having samples CDC and SC, but the percentage slightly increased (non-significantly i.e. $P \geq 0.05$) in the informed condition. For all the samples, there was a non-significant ($P \geq 0.05$) increase in the number of participants who felt “active” once the health claim information was provided to them. Somewhere, interest of participants reduced non-significantly ($P \geq 0.05$) by 2-3% in the informed condition for all the samples except for CR where there was 10% increase (non-significant $P \geq 0.05$) in the number of participants who reported to be “interested” in the sample. No one felt “guilty” after having CGB in the informed condition whereas 7.5% participants were “guilty” of having sample CDC in the informed condition. Participants (11.3%) had a feeling of “regret” after consuming CGB in the blind condition which was decreased non-significantly ($P \geq 0.05$) by 10% after the informed condition. For all the samples, there was non-significant ($P \geq 0.05$) increase in the number of participants who felt “sad” after the health claim information was delivered to them. After consuming samples CDC and SC in the informed condition, 5-6% participants claimed to feel “worried”. 37.5% participants were “neutral”

¹⁰ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
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CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

about the sample SC¹¹ in the blind condition and the least number of participants i.e. 16.3% were “neutral” after consuming the sample CDC in the informed condition. In case of session 2, where health claim information was given to the participants, number of participants who felt “comfort” decreased non-significantly ($P \geq 0.05$) except for CDC where percentage of participants increased non-significantly ($P \geq 0.05$).

¹¹ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
CR-Cranberry and Raspberry
CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

Table 3.4: Frequency* (%) of participants experiencing emotions in four protein bars in both the sessions**

Emotions***	CGB ¹²		CDC		CR		SC	
	Blind	Informed	Blind	Informed	Blind	Informed	Blind	Informed
Happy	26.3ab	21.3ab	11.3a	18.8ab	27.5ab	33.8b	13.8a	20.0ab
Healthy	37.5ab	38.8ab	28.8ab	28.8ab	33.8ab	42.5b	23.8a	40.0ab
Calm	15a	20.0a	13.8a	8.8a	17.5a	16.3a	15.0a	18.8a
Pleasant	33.8b	31.3ab	13.8a	20.0ab	35.0b	32.5ab	18.8ab	22.5ab
Satisfied	27.5a	27.5a	21.3a	18.8a	26.3a	26.3a	26.3a	21.3a
Good	47.5b	37.5ab	21.3a	35.0ab	36.3ab	32.5ab	18.8a	26.3ab
Enjoyable	31.3a	27.5a	18.8a	21.3a	27.5a	31.3a	26.3a	25.0a
Active	13.8a	16.3a	6.3a	18.8a	11.3a	12.5a	13.8a	16.3a
Interested	33.8a	30.0a	22.5a	20.0a	22.5a	32.5a	22.5a	20.0a
Nurturing	13.8a	16.3a	15.0a	7.5a	21.3a	15.0a	12.5a	13.8a
Guilty	1.3a	0.0a	5.0a	7.5a	0.0a	3.8a	1.3a	1.3a
Regret	11.3a	1.3a	8.8a	7.5a	2.5a	3.8a	3.8a	10.0a
Sad	3.8a	5.0a	6.3a	7.5a	2.5a	5.0a	5.0a	6.3a
Worried	2.5a	5.0a	3.8a	6.3a	1.3a	1.3a	2.5a	5.0a
Disgusted	3.8a	2.5a	7.5a	8.8a	0.0a	2.5a	2.5a	7.5a
Neutral	26.3ab	27.5ab	30.0ab	16.3a	28.8ab	21.3ab	37.5b	22.5ab
Bored	7.5a	10.0a	18.8a	18.8a	13.8a	6.3a	21.3a	13.8a
Hate	1.3a	2.5a	5.0a	5.0a	2.5a	3.8a	5.0a	6.3a
Unpleasant	8.8a	16.3a	20.0a	21.3a	6.3a	12.5a	15.0a	20.0a
Comforting	26.3b	16.3ab	10.0ab	13.8ab	21.3ab	15.0ab	16.3ab	6.3a

* Total percentage of participants experiencing particular emotion in the protein bar being tasted. Percentage in the same row followed by different letters are significantly different (P <0.05)

** Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

*** Emotions experienced by the panellists were assessed with the use of CATA.

¹² CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

The Correspondence Analysis showing the representation of protein bars in both the sessions in relation to the emotion terms of the CATA question is presented in the Figure 3.3. Samples CR-I¹³ and CGB-B were associated with the emotion terms “happy”, “pleasant”, “active”, “healthy”. On the other hand, CR-B and CGB-I were related to emotion terms “nurturing”, “comforting”, “satisfied”, “enjoyable”, “calm” and “interested”. Samples SC and CDC in blind session were related to emotion terms “hate”, “bored” and “neutral” whereas in informed session SC and CDC were associated with emotion terms “sad”, “unpleasant”, “worried”, “regret”, “active”, “guilty” and “disgusted”. Overall, regardless of the session of blind and informed, positive emotion terms were associated with the sample CGB and CR and on the other hand, negative emotion terms were related with the samples CDC and SC. There was no significant difference between the emotions perceived by participants while consuming the samples when the information was given.

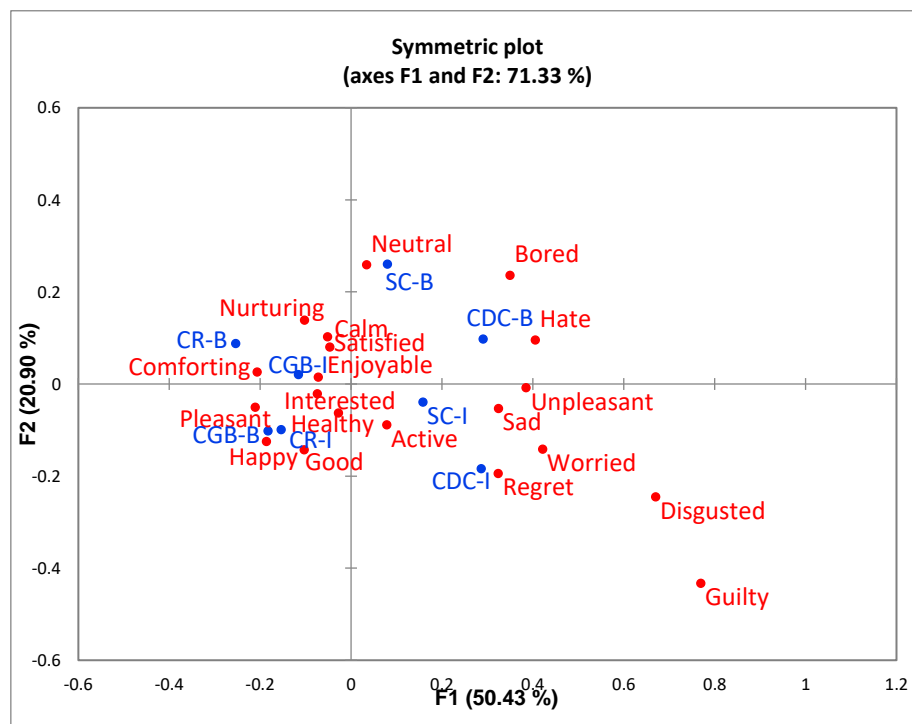


Figure 3.3: Correspondence Analysis of emotion terms for each protein bar* in both the sessions**

*Four protein bars used

** Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

¹³ CGB-Coconut and Goji Berry with Dark Chocolate

SC-Salted Caramel

CR-Cranberry and Raspberry

CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries

B-Blind (Health claim information not given)

I-Informed (Health claim information given)

3.3 Purchase Intent

The frequency of purchase intent for each sample with the condition of blind and informed has been calculated and summarized in the Table 3.5. The highest purchase intent was observed for CR sample and minimum for SC sample. Purchase intent for 3 samples i.e. CDC, CR, SC increased non-significantly ($P \geq 0.05$) by about 6%, 3% and 4% respectively and decreased non-significantly ($P \geq 0.05$) in the case of CGB by about 6% after the health claim information was given to the participants. Therefore, it is evident from the Table 3.5 that health claim information has positively changed the purchase intent for three samples out of four; however, the difference was not significant ($P \geq 0.05$).

Table 3.5: Frequency* of purchase intent (%) of participants for four protein bars in both the sessions**

Sample Name	CGB ¹⁴		CDC		CR		SC	
Condition	Blind	Informed	Blind	Informed	Blind	Informed	Blind	Informed
Purchase Intent	62.5ab	56.3ab	46.3ab	52.5ab	66.3ab	68.8b	43.8a	47.5ab

* Total percentage of participants showing their purchase intent for each of the protein bar being tasted. Percentage in the same row followed by different letters are significantly different ($P < 0.05$)

** Session 1(Blind), where no information was provided and session 2 (Informed), where health claims were delivered

¹⁴ CGB-Coconut and Goji Berry with Dark Chocolate
 SC-Salted Caramel
 CR-Cranberry and Raspberry
 CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
 B-Blind (Health claim information not given)
 I-Informed (Health claim information given)

Chapter 4

Discussion

Discussion:

4.1 Significant Difference in the Protein Bars (Samples)

In this study, there was no significant difference between the effect of health claims provided and not provided for protein bars to the participants. However, there was significant difference between the samples with respect to the different sensory attributes. CGB¹⁵ and CR were liked the most as compared to CDC and SC. Difference between the liking of particular attribute among the four samples of protein bars or any food item mainly depends on the ingredients involved and also on the composition of ingredients. According to Hewson et al (2008), interaction between sugar and fruity aromas/flavours takes place as per the potentiation, which means the cranberry, raspberry, gojiberry, strawberry flavour augments in the presence of optimum levels of sugar and is liked by consumers. Also, fruity flavours tend to mask other flavours like cocoa to some extent and in the absence of such flavours, food tends to taste more bitter. Sugar content is inversely proportional to the bitterness i.e. less the sugar more the bitterness in chocolate. Therefore, samples CDC and SC (without the aromatic ingredients like cranberry, raspberry and gojiberry) had less acceptability among consumers (Vienna, 2006).

It has also been noticed that sweetness and sourness together have a synergistic effect on the overall taste of the product and can be tasted properly if are present in the optimum concentration and hence are liked by consumers as seen in this study in the case of CGB and CR samples (Zaouay et al., 2014). The liking towards the food product decreases if it comprise of the ingredient soy. Protein bars have soy in it and sometimes it can give the bitter aftertaste if not masked by other flavours. It has been reported that negative taste perception can hinder with the acceptance or liking of products, which have soy as their ingredient (Tu et al., 2012).

¹⁵ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
CR-Cranberry and Raspberry
CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

4.2 Effect of Age on impact of Health Claims

In the current study, presence of health claims did not influenced the acceptability of protein bars. There could be several reasons for support the results obtained. In this study, 77.5% of the panellists aged less than 35 and about less than 1/4th of the total number of consumers were mature (more than 35 years). It has been proved that mature people with age more than 35 years tend to be more interested in health related information associated with food products as compared to the younger age group. This could be the reason for non-significant response towards the health claims provided (Azzura & Paula, 2009). Older consumers are more likely to buy food products labelled with health claims (Ares et al., 2012; Bower et al., 2003). Another reason could be the amount of information provided to the participants.

4.3 Complex Information

According to Wansink (2003), too much information related to health claim may result in the confusion for participants as a consequence they become disinterested and make different food choices. Moreover, using fancy, complicated and more scientific words in the health claim information can also be the reason for less effect and communication with the consumers (Aschemann-Witzel & Grunert, 2015). Short and simple health claims have more believability among consumers as compared to the long health claims (Wansink, 2003).

4.4 Familiarity

Familiarity towards food product also plays an important role in the decision making. Familiarity can be referred as some past experience of consumers with any sort of information on the products like health claims and nutritional claims. There is a positive connection between the familiarity and preference towards the food item (Giacalone & Jaegar, 2016). If the consumers are presented with familiar health claims, there are higher chances of positive influence towards acceptability (Steinhauser & Hamm, 2018). Every individual is different and consider any piece of knowledge in a different way. For instance, if a person had any bad experience with the particular food product there are high chances that it can interfere with the influence of information (Sabbe, Verbeke & Van Damme, 2009). Furthermore, health-related claims cannot guarantee the benefits in all the cases and if somebody has experienced the no-benefit claim, consumers can simply ignore the information provided and will not be motivated to spend their time in perceiving the information in decision making (Hung et al., 2017; Rotfeld, 2010). This suggests that consumers tend to use their past experience and knowledge of health claims provided with respect to any food product (Steinhauser & Hamm, 2018). Consumers tend to stick to their prior beliefs associated with food products. Another

example could be, it was observed that in the informed case, number of participants who tasted sweetness decreased by 5% as compared to the blind condition in case of the sample CR. This could be due to their prior belief that sweetness is associated with sugar and perhaps healthy food products have less sugar. (Harrison, 2009). Therefore, consumer's familiarity with this belief gave such analysis which proves that familiarity plays crucial role in acceptance of food product and ultimately their decision making.

4.5 Influence of portion size and Expectations

Another reason could be the portion size. In the past studies, it has been proved that if the portion size is not sufficient, the consumer's liking towards the product decreases regardless of health claims and it is possible that the particular food product's purchase can decrease as the consumer knows that there are other equally or even healthier options with appropriate portion size like fruit. In this sense, the effectiveness of health claims decreases when satiation is the priority (Pinto et al., 2017). Also, the expectation of consumers has a major role. Every consumer has expectations from the product and associated information and are more likely to choose the food item with pre-purchase expectations about the anticipated performance. Expectation confirmation is associated with consumer's trust and high acceptability and purchase intention (Wang et al., 2009). If the expectations of consumers are not matched positively, the efficacy of health claims declines (Burgess, 2016).

4.6 Emotions and Purchase Intent

Purchase intent for any food product can be commanded by emotions. Studies show that there is a relationship between the intention of buying healthy products and cognition of emotions (Wang et al., 2009). Arousal of positive emotions while consumption of food product tend to have higher purchase intent as compared to negative emotions. As seen in the present study, protein bars CGB¹⁶ and CR were more associated with positive emotions such as "happy", "satisfied", "pleasant", "enjoyable", "active", "good" and others hence had higher purchase intent among consumers as compared to the protein bars CDC and SC as they were more related with negative emotions such as "guilty", "bored", "hate" "regret" and others by the consumers.

¹⁶ CGB-Coconut and Goji Berry with Dark Chocolate
SC-Salted Caramel
CR-Cranberry and Raspberry
CDC-Coconut and Real Dark Chocolate with Freeze Dried Raspberries
B-Blind (Health claim information not given)
I-Informed (Health claim information given)

4.7 Preference: Health Claims or Taste?

According to Pinto et al (2017), consumers do not depend totally on the health claim information provided while purchasing the food item as for them taste and flavour also plays an important role. Health claims mainly comes into consideration depending on the individual need for example medical recommendation (Pinto et al., 2017). The health claims are not capable of changing the hedonic responses towards the food product as consumers do not prefer sacrificing sensory pleasure for the sake of health benefits in any food product if they do not like the taste and other attributes (Monaco et al., 2005; Vidigal et al., 2011).

To sum up, this study showed that consumers prefer taste and texture over health related claims in case of protein bars. However, they got influenced but non-significantly by the health claims provided. There was marginal change in the emotion and purchase intent when health claim information was provided but it did not affected significantly.

Chapter 5

Conclusion

In the current study, it was observed that there was no effect of health claims on consumer's acceptability of protein bars. Consumer characteristics such as expectations, familiarity and believability in the information associated with the food product may moderate the impact and efficiency of health claims. Also, there was no significant change observed in the emotions and purchase intent of consumers when the health claim information was delivered. Highest purchase intent was associated with positive emotions. Overall, participants preferred taste and texture of protein bars over the health claims conveyed to them. There is a need to improve the sensorial quality of different types of bars present in the market. In order to have a significant influence on the food products acceptability, health claims should be concise and easy to be understood by the consumers. It is important to conduct such consumer test studies to have a better idea of what consumers demand from the food industry. Also, there is a need to look at future trials with respect to the intra-individual variability in context with the repeated exposure of a particular food item.

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