

Nutrition Claims Credibility on Lebanese Bread: A Cross-sectional Study

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Abstract

Lebanese bread is a staple food consumed with every meal and great vehicle for a range of nutrients. Nowadays, manufacturers use nutrition and health claims (NHC) to communicate the nutrients contents and benefits of the food while increasing sale and competitiveness. In absence of stringent standards regulations and control, misleading claims could jeopardize consumers' public health. The aim of this study was to examine pre-packaged Lebanese breads in Mount Lebanon, to assess their compliance with the Lebanese (LIBNOR NL 661:2017) and/or international standard CODEX (CAC/GL 23-1997) to carry the nutrition claims. All the displayed Lebanese bread at all the registered bakeries in Mount Lebanon (n=25) were assessed using the nutrition facts panel and standard nutrient analysis methods. Of all breads (n=75), 84% carried nutrition claims, and 25.3% carried health claims. Among nutrition claims, 70.7% had non-addition claims, 56% nutrient content claims, and 1.3% comparative claims. Almost half (45.3%) of the bread had claims related to sugar, 41.3% to fiber and 32% to salt. Based on the nutrition facts panel, only 32.4% were eligible to make the sugar content claims, 45.5% to fiber content and 54.4% to salt. Based on the chemical nutrient analysis, only 47.0% were eligible to make the sugar content claims, 16.1% to fiber and 37.5% to salt. All the claims related to protein (n=7) were compliant.

These results suggest the urgent need to develop clear guidelines for the effective implementation of the current standard. Additional regulation and routine testing are also recommended to control better the use of those claims to reduce the number of illegal or apparently unsubstantiated claims. Community-based education programs are also needed

to encourage consumers to use properly the claims upon shopping and increase their awareness about issues and flaws related to food labeling claims.

Keywords: Nutrition claims; health claims; bread; Lebanon; labeling; fiber; sugar; salt; protein

Abbreviations List

AACC	Analytical Association of Cereal Chemists
AAS	Atomic Absorption Spectroscopy
AOAC	Association of Analytical Chemists
CAC	Codex Alimentarius Commission
CVD	Cardiovascular diseases
EC	European Commission
EUFIC	European Food Information Council
FAO	Food and Agricultural Organization of the United Nations
FSANZ	Food Standards Australia New Zealand
HCl	Hydrochloric acid
H ₂ SO ₄	Sulfuric acid
LIBNOR	Lebanese Standards Institution
LMICs	Low and Middle Income countries
MENA	Middle East and North Africa
MoPH	Ministry of Public Health
NaOH	Sodium hydroxide
NCDs	Noncommunicable chronic diseases
NCD-PCP	Noncommunicable Disease Prevention and Control Plan
NF	Nutrition facts panel
NL	Normes Libanaises
NHC	Nutrition and Health claims
WHO	World Health Organization

Chapter I

Literature Review

1.1. Introduction

Noncommunicable diseases (NCDs), also known as chronic lifestyle-related diseases cause 71% of all deaths globally and represent a huge burden on individuals, governments and societies (WHO, 2015). NCDs are putting a huge pressure on health care systems and resources, which is particularly challenging for low and middle income countries (LMICs) (WHO, 2015).

The Middle East and North Africa (MENA) region, mainly constituted of LMICs has experienced rapid urbanization and a shift towards unhealthy lifestyles, leading to an increase in the burden of NCDs at an alarming rate, and making it a leading cause of mortality in the region by claiming more than 2.2 million lives in 2012 (WHO, 2015). The main four NCDs in the region are related to cardiovascular diseases (CVDs), cancers, respiratory diseases and diabetes (Figure 1.1). The major risk factors associated with these diseases can be metabolic factors like hyperglycemia and, high blood pressure, and modifiable behavioral factors like excessive sodium intake, which accounts for 4.1 million annual deaths (WHO, 2017a).

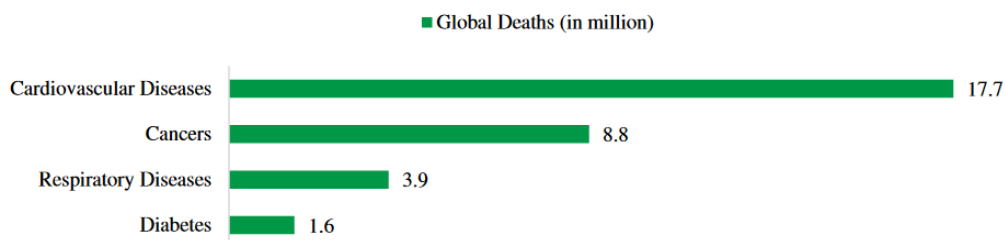


Figure 1.1 Global causes of mortality (WHO, 2016, 2017b).

In Lebanon, just like other developing countries, NCDs' mortality and morbidity burden, have been replacing communicable diseases since the 1990s until they became very well-established. In 2014, they were estimated to account for 85% of total deaths, the main causes including cardiovascular diseases CVDs (47% of deaths) and diabetes (4% of deaths) (Figure 1.2) (WHO, 2014). The detrimental effects of these diseases on population's health, quality of life, healthcare system, and economy, urged the formulation of strategies and initiatives by public agencies and organizations of the civil society, to tackle NCDs and halt their progress (WHO and MoPH, 2016). Recognizing that key components in the management of such diseases and their risk factors are adopting healthier lifestyles and dietary choices (WHO, 2017a; 2017b), the increased awareness about the relationship between dietary intake and health changed the consumer needs in the food field (Sidhu *et al.*, 2007). The demand of healthy products has increased, with a shift from the consumption of traditional products towards improved and altered versions. Consumers are now opting for food products with emphasize on their nutritional benefits and their role in promoting health and well-being (Siró *et al.*, 2008; Mitić and Gligorijević, 2015). For the food sector, the increased health concerns, created pressure and challenges to produce "healthier" alternative options (Lähteenmäki, 2018). In order to meet these changing consumer needs and global market development trends, producers and retailers are revising their strategies and developing new functional and healthier food products. (Siró *et al.*, 2008). Moreover, as one of the most important measures in promoting healthy eating, food manufacturers, along with governments, are promoting nutrition labelling like nutrition and health claims, in order to help consumers in making informed decisions at the point-of-sale (Davidović *et al.*, 2014).

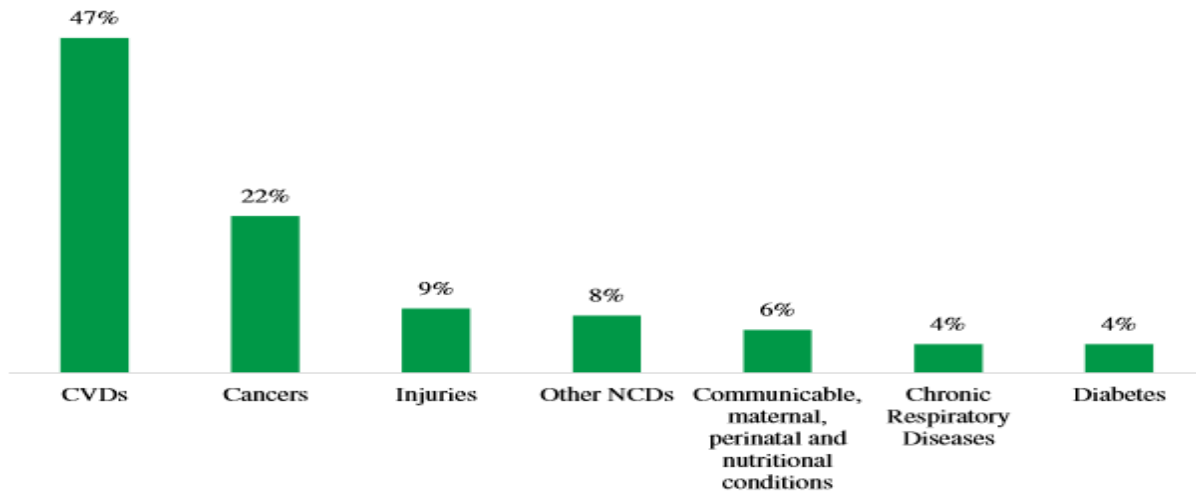


Figure 1.2. Mortality causes in Lebanon (WHO, 2014, 2017b).

1.2 Food labelling: Nutrition and Health claims

Nutrition labelling is an important communication tool, providing point-of-sale information about a product's nutritional attributes, thus, helping consumers make product comparisons and selections (Nocella and Kennedy, 2012; Hellyer *et al.*, 2014; Vella *et al.*, 2014; Wingfield, 2016). Based on the Codex Alimentarius Commission (CAC), responsible for setting standards and guidelines on labelling, nutrition labelling has two major components: first the nutrition declaration and second the supplementary nutrition information like nutrition and health claims (NHC).

1.2.1 Nutrient Declaration

A nutrient declaration, more commonly known as the nutrition facts panels, is a listing of the nutrient content of a product. Nutrition facts are mandatory on most of prepackaged food product,

unless the food is of dietary insignificance (small amount) or small packaging; however, it is mandatory wherever a nutrition or health claim has been made (CAC/GL 2-1985).

1.2.2 Claims

A claim is any statement made on a product suggesting that the latter has any special characteristic regarding its nutritional content, origin, composition or any other quality (CAC/GL 1-1979). Different types of claims can be found on food products. Health claims imply an association between a food and health. Nutrition claims convey information about specific nutritional properties of the food. Subgroups of nutrition claims are: nutrient content claim intending to determine a certain level of a nutrient for example “low”, “high”, “source”; nutrient comparative claims comparing two or more products using words like “reduced” and “increased”; and non-addition claims pointing that an ingredient that is normally present in this food has not been added during production either directly or indirectly (CAC/GL 23-1997).

1.2.3 Nutrition and Health Claims regulation

Nutrition and Health claims are controlled by legislation to protect consumers from any fraudulent or misleading information. Regulatory frameworks for claims were primarily developed in United State of America (USA) and Japan. The Food and Agricultural Organization of the United Nations (FAO), works with the World Health Organization (WHO), to advise the CAC on setting standards and policies to food labelling (FAO, 2019). The first international standard adopted by the CAC in 1969 is the General Standard for the Labelling of prepackaged food. The Codex Committee on Food Labelling is the body responsible for the preparation of labelling texts (Albert, 2010). The Codex standards were later internationally harmonized and used by countries as a basis for new

policies (Nocella and Kennedy, 2012; FAO, 2019). In the USA, the standards are regulated by the Food and Drug Administration (FDA) and the US Department of Agriculture (USDA) (Wingfield, 2016). In Europe, to ensure clear, accurate, and scientific claims, Regulation (EC) No. 1924/2006, states that only pre-approved and verified claims can be used on food products (Lähteenmäki *et al.*, 2013). In Australia, in addition to the Food Standards Australia New Zealand (FSANZ), there's a Code of Practice on Nutrient Content Claims to ensure the accuracy of the reported labels (Williams *et al.*, 2003).

Regulatory policies vary greatly across countries; hence, nutrition labelling is either mandatory or voluntary. Moreover, some countries do not have any control or regulations on claims and labelling (Hawkes, 2014). In 2004, the WHO reported that among 74 countries, only 10 adhered to mandatory food labelling policy. However, in 2016, an update review by the European Food Information Council (EUFIC), reported an increased trend towards this mandatory policy (Kliemann *et al.*, 2018). Currently, food labelling is mandatory in several countries like members of the European Union, Brazil, Argentina, USA, Canada, Mexico, Arabian Gulf countries and many others (Kliemann, 2018; EUFIC, 2016). Some countries, including Turkey, Singapore, Morocco, Jordan, and Switzerland have guidelines established by the government, but following those standards is voluntary (EUFIC, 2016).

In Lebanon, the Lebanese Standards Institution (LIBNOR), which is attached to the Ministry of Industry has solely the right to prepare, publish, and amend national standards in the fields of quality and food safety. Nutrition labelling is voluntary in Lebanon, unless a nutrition or health claim is made, therefore, the presence of a nutrition facts panel becomes mandatory (EUFIC, 2016;

NL 719:2017). Nutrition facts panels are mandatory based on Normes Libanaises (NL) 719 (NL 719:2017). Some food like spices, salt, fruits, vegetable, fresh meat, poultry, fish are exempted from displaying the nutrition facts, however, nutrition facts is mandatory for the exempted foods as well as all other pre-packaged food whenever a nutrition or health claim is made (NL 719:2017). Regarding health and nutrition claims, LIBNOR has specific standards for NHC, “General guidelines for claims” (NL 660:2017); “General guidelines for the use of nutrition and health claims” (NL 661:2017); and “General guidelines for nutrition labelling” (NL 719:2017). All these regulations are based on the international guidelines provided by Codex. The main objective of these guidelines is to prevent misleading claims, and ensure that they are scientifically based (Randell, 2010). Moreover, some staple foods like Lebanese bread have their own standards, including a standard of identity, certain norms related to the product, in addition to sampling and testing techniques (NL 240:2010). So far, apart from these guidelines, no other decree or decision have been published regarding the implementation, regulation or control of these claims and labels.

1.2.4 Uses of Nutrition and Health Claims

The implementation of the regulations and standards is not only important to protect consumers from fraudulent claims but also to ensure fair competition between food manufacturers (Albert, 2010). Moreover, the food sector uses nutrition labelling and claims as powerful marketing tools that may influence consumers’ decisions by increasing their knowledge about certain attributes of their products, thus increasing demand and sales (Koen *et al.*, 2016). A meta-analysis of 17 studies, showed that NHCs have the potential to increase consumption and purchasing (Kaur *et al.*, 2017). Therefore, there has been an increased prevalence of NHC on prepackaged food (Davidović *et al.*, 2014; Koen *et al.*, 2016).

1.3 Prevalence of Nutrition and Health Claims

The use of NHC has been on the rise worldwide (Williams *et al.* 2003; LeGault *et al.*, 2004; Salnikova *et al.* 2014; Murniece *et al.* 2014; Pravst and Kušar 2015; Hieke *et al.* 2016; Koen *et al.*, 2016). NHC claims were found on most of pre-packed products like frozen and refrigerated fruits juices, drinks, beverages, crackers, bread and bakery goods, meat/poultry substitutes, cereals, and dairy products (LeGault *et al.*, 2004; Lwin *et al.*, 2015; Pravst and Kušar, 2015).

Recently, a study assessing the prevalence of NHC in five countries in Europe, reported that among 2034 food products, 26% carried at least one claim. Among those claims, 64% were nutrition claims and 29% were health claims. Nutrition claims were mainly reported in UK (30%), followed by Spain (23%), Slovenia (19%), Netherlands (17%), and Germany (16%). Health claims showed less variations across countries with Netherlands recording the highest prevalence of 14% and Spain the lowest with 7% (Hieke *et al.*, 2016). A similar study carried in the UK, in 2014, reported that 32% of products (n=400) carried at least one claim, 29% had nutrition claims, and 15% had health claims (Kaur *et al.*, 2015). The higher prevalence of nutrition claims as compared to health claims was also observed in several countries. In Australia, among 329 breakfast cereals, 95.7% were reported to have at least one NHC, with nutrition claims (83.7%) being more prevalent than health claims (16.3%) (Sussman *et al.*, 2019). In Serbia, an audit on pre-packaged foods (n=2138), showed a lower prevalence of nutrition and health claims (6.6% and 6.3% respectively) (Davidović *et al.*, 2014). In Slovenia, 37% of products (n=6342) presented nutrition claims and 13% had health claims (Pravst and Kušar, 2015). In Ireland, the highest prevalence was that of nutrition claims as compared to health claims (47.3% and 17.8% respectively; n=1880) (Lalor *et al.*, 2010). In Canada, a study investigating claims on food in 2013, showed that 49% displayed at least one

claim, 46% carried nutrition claims and 1.5% had health claims (Franco-Arellano *et al.*, 2017). In Singapore, the greatest proportion of claims were non-nutrient claims (56.4%) like “natural” and “healthy”, while health claims were only present on 4.7% of products (n=383) (Lwin *et al.*, 2015).

Table 1.1. Summary of the prevalence of Nutrition and Health claims in several countries

Country	Product	Sample size (n)	Nutrition claim (%)	Health claim (%)	Reference
UK	Random	382	29	15	Kaur <i>et al.</i> , 2015
Australia	Breakfast cereals	329	83.7	16.3	Sussman <i>et al.</i> , 2019
Serbia	Pre-packaged food	2138	6.6	6.3	Davidović <i>et al.</i> , 2014
Slovenia	Random	6342	37	13	Pravst and Kušar, 2015
Ireland	Products of four retailers	1880	47.3	17.8	Lalor <i>et al.</i> , 2010
Canada	Prepackaged food	15286	46	1.5	Franco-Arellano <i>et al.</i> , 2017
Europe	Random	2034	64	29	Hieke <i>et al.</i> , 2016

1.4 Consumers' Use and Perception

Although, consumers are all highly exposed to claims worldwide, the use and perception of these claims varies greatly across countries due to different cultures, regulations and levels of understanding (Figure 1.3) (Landström *et al.*, 2009; Masson *et al.*, 2016). In Ireland, 65% of individuals occasionally look for food labels, compared to 50% in Sweden, 38.8% in Spain, 20% in UK and 14% in Australia (Lalor *et al.*, 2010; Prieto-Castillo *et al.*, 2015, Wong, 2015). In

Canada, food labels are the main source of nutrition information for 67% of the population, with 21% and 18% seeking out nutrition claims and health claims respectively (Goodman *et al.*, 2011). In Lebanon, a recent study among supermarket shoppers (n=748), showed that 29.3% of consumers read food labels when buying a product, and 44.4% think that reading those labels is very important. Moreover, labels have helped 60.3% of shoppers change their habits and 59.8% reported that NHC have affected their product selections (Hassan and Dimassi, 2017).

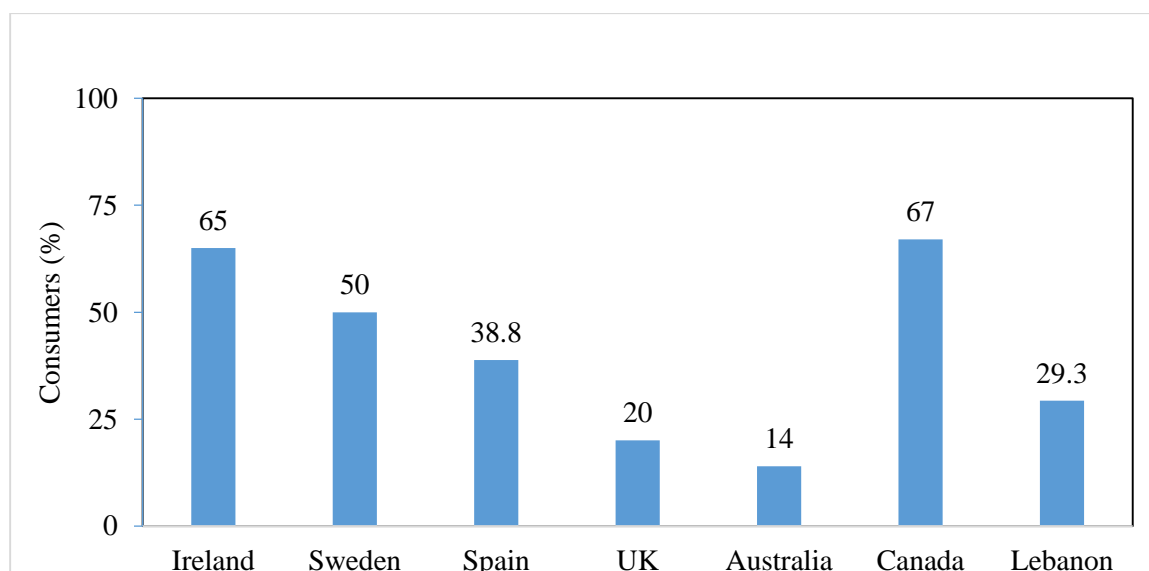


Figure 1.3. Percentage of consumers occasionally reading food labels (Lalor *et al.*, 2010; Goodman *et al.*, 2011; Prieto-Castillo *et al.*, 2015; Wong, 2015; Hassan and Dimassi, 2017).

Research has shown that people are genuinely, interested in labels and claims (Nocella and Kennedy, 2012). This is mainly due to the “health halo” effect they have on consumers. NHCs may lead consumers into generalizing that a product has healthier properties than it actually does, by giving a higher nutritional rating to attributes not even related to the claim (Van Trijp and Van der Lans, 2006; Rodrigues *et al.*, 2016; Kaur *et al.*, 2017; Franco-Arellano *et al.*, 2018; Benson *et al.*, 2019).

However, several factors related to the consumer, product, and the claim itself affect the perceived relevance and influence of NHC claims (Lähteenmäki, 2013) (Figure 1.4).

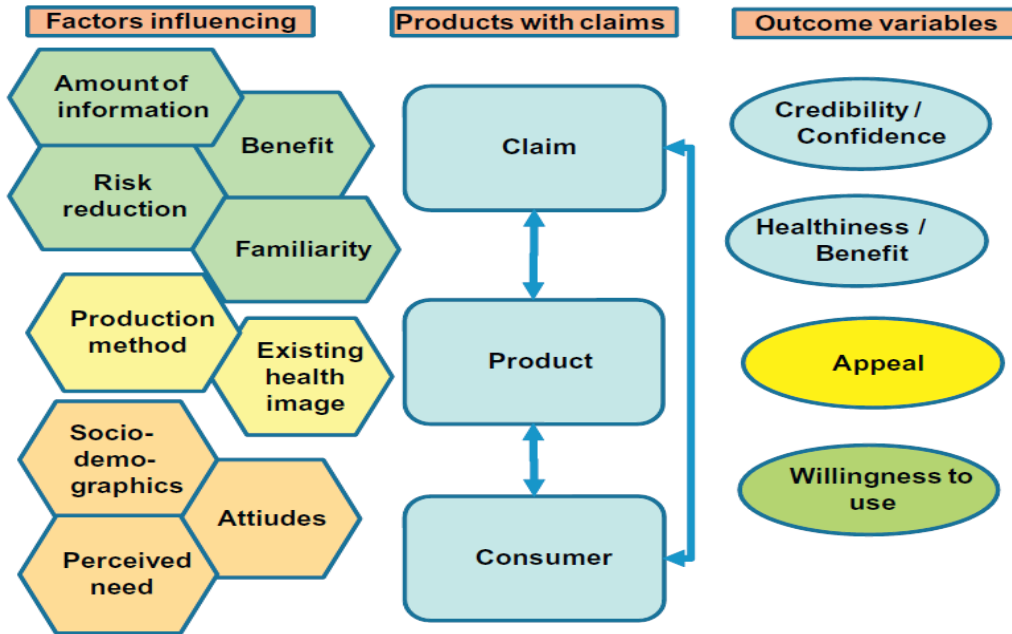


Figure 1.4. Factors affecting perception of claims (Lähteenmäki, 2013).

Socio-demographic characteristics like age, gender, education level, as well as economic factors like income were shown to be key factors influencing consumers' knowledge, awareness and consumption of products with NHC claims (Mitić and Gligorijević, 2015). Several studies have shown that women, people with higher educational level as well as those under 35 years old, show higher interest, and knowledge in food labels and NHCs (Lynam *et al.*, 2011, Lähteenmäki, 2013, Mitić and Gligorijević, 2015; Prieto-Castillo *et al.*, 2015; Gezmen-karadag *et al.*, 2017; Hassan and Dimassi, 2017; Khnaisser *et al.*, 2019).

On the other hand, product-related factors, had also an influence on the effect of claims on consumers' choice (Lähteenmäki, 2013). For example, health claims were more accepted on products already bearing a healthy image (Lähteenmäki, 2013). According to Hassan and Dimassi (2017), 30.3% shoppers responded that reading labels depended on the item purchased. Familiarity with the claim, and knowledge also affected the acceptability and attitudes towards NHCs (Lähteenmäki, 2013). It is also commonly known that some consumers have negative attitudes towards claims as they are skeptical or may be confused by the statements made (Mitić and Gligorijević, 2012; Benson *et al.*, 2019). People are more likely to believe NHCs if they had knowledge of ingredients, or established nutrient-disease relationship like calcium and bones' health (Benson *et al.*, 2019). In addition, the doubt about the truthfulness in claims may be due to the fact that consumers often see them as a form of promotion and marketing tool, making them rely more on nutrition panels (Mitić and Gligorijević, 2012).

1.5 Ethical issues in Nutrition and Health Claims

Another major factor affecting consumers' acceptability and attitudes towards NHCs, are the level of trust in those claims, and the implementation of their related regulations (Lähteenmäki, 2013).

Food products carrying NHCs have been shown to mislead consumers by highlighting the beneficial nutrients of the product and minimizing information on nutrients of public concern like fat, sodium, and sugar. Thus, consumers will be tricked into buying products just because of the presence of claims, but that may be of low nutritional quality (Franco-Arellano *et al.*, 2018). Moreover, for consumers who rely on nutrition facts when a claim seems doubtful, some studies

have suggested that variation in declared serving size may lead to lower amounts reported and affect consumers' understanding of nutrition information (Kliemann *et al.*, 2016; 2018).

By law, a health claim should be formulated in a way that allows consumers to understand the beneficial effects of the product (EC-Regulation No. 1924/2006) but it should also reflect the real content of the product (*CAC/GL-23-1997; NL 660:2017*) (Salnikova *et al.*, 2014). Non-compliance of claims with the standards and guidelines have been reported in both developed and developing countries.

1.5.1 Compliance of Nutrition and Health Claims in developed countries

In Australia, several studies have been conducted in order to assess the compliance of nutrition and health claims with Australian standard. An audit on breakfast cereals (n=1309), showed that 91.6% of claims were compliant to the standards, with nutrition claims having a higher percentage of compliance than health claims (93.6% and 81.2% respectively) (Sussman *et al.*, 2019). In contrast, when evaluating ultra-processed foods (n=215), Pulker *et al.* (2017), reported a greater compliance of health claims (78.9%) as compared to nutrition claims (17.8%). In addition, an audit on breads, showed that within breads marketed in Australia (n=456), 28% were eligible to make a “whole grain” claim, 54% “source of fiber”, 57% “source of protein” and 90% “low sugar” claim (Grafenauer and Curtain, 2018).

In Canada, within a sample of 15184 product evaluated, 6990 (46%) were found to carry nutrition claims and 58.1% (n=4060) of those products were eligible to make the claims on the package (Franco-Arellano *et al.*, 2018). In Slovenia, an evaluation of the sodium content among a sample of 5104 food products, showed that none of the products within the bread, processed meats and

cheese categories were eligible to make the sodium related claims found on the package (Korošec *et al.*, 2014).

1.5.2 Compliance of Nutrition and Health Claims in developing countries

In developing countries, like Honduras, an evaluation of critical nutrients in functional foods (n=144), showed that 100% sweetened juices, breakfast cereals and baked products met claim criteria of “cholesterol free”. Similarly, cereal bars (86%), cheeses (71%) and cookies (71%), also had a great proportion meeting this criterion. In addition, 15% of sweetened juices were eligible to claim “calorie free”. All cereal based products and 64% of baked goods met the criteria for “source of dietary fiber” and “high source of dietary fiber” claims respectively (Santana *et al.*, 2019).

In Malawi, another type of non-compliance with the requirements was observed, where 32.9% of products surveyed (n=316), had nutrition claims with no nutrition facts value, and nutrition facts values become mandatory whenever a claim was made (Kasapila *et al.*, 2013).

In Lebanon, an analysis of a sample of breads (n=48) commonly consumed like pita, Tannour, Markouk, and French baguette, noted the absence of sodium in breads with “zero-salt” labels and 0.32% salt in breads stating to be low in salt. The results obtained indicate the credibility of sodium related claims on breads assessed (Al Medawar *et al.*, 2015). More recently, a study among gluten-free-labeled foods in the Lebanese market (n=173), reported that 33 (19%) contained gluten between 2.5 and 80 mg/kg and in 10 samples the quantity exceeded the upper-limit of 20 mg/kg (Hassan and Dimassi, 2017). Knowing that 59.8% (n=748) of shoppers base their choices on health and nutrition claims (Hassan and Dimassi, 2017), such discrepancies in food labelling should be

considered of high concern not only for products that are critical for certain diseases but also for products that are heavily consumed in the country like bread.

1.6 Bread: Staple food / vehicle for functional ingredients

Bread has been part of people's diet for many decades. Falling as a major product in the cereals food group, it is classified as a worldwide staple food. On a daily basis, it is estimated that one portion of bread is consumed by more than half of the Slovenian population, a mean average of 72 g of bread are consumed by Australians and around 500 g by Moroccans (Korošec and Pravst, 2014; Jafri *et al.*, 2017; Grafenauer and Curtain, 2018). Quilez and Salas-Salvador, (2012), summarized bread consumption in several European countries. Turkey recorded the highest consumption with 411g per day, followed by Bulgaria (266 g/day), and Cyprus (203 g/day). A consumption of 192 g/day was reported in Denmark, Greece, Poland and Portugal (Quilez and Salas-Salvador, 2012). It is also a very popular food in the Gulf Cooperation Council countries (Al Jawaldeh and Al Khamaisseh, 2018). In Lebanon, a daily consumption of 136.8 g. person⁻¹ of bread was estimated; the main types being pita, markouk and tannour (Al Medawar *et al.*; 2015). Bread provides a range of nutrients for its consumers. The National Diet and Nutrition Survey (2009) in the UK demonstrated that more than 10% of the daily protein and some micronutrients needs like folate, niacin, thiamin and zinc can be provided by bread. On the other hand, bread is also a major vehicle for nutrients that are essential component in people's diet and that either contribute or help prevent disease. For example, sugar has been major contributor to obesity and diabetes and bakeries tend to avoid adding it to bread; while fibers being the most well-known functional ingredients by consumers have been widely associated with health benefits like reduced

risk of cancer, improved digestion, post-prandial glucose and insulin, hence reduce the risk of major NCDs like CVDs and diabetes (Sidhu *et al.*, 2007).

In addition, bread has been classified as a major contributor of dietary salt in many countries like USA, Australia, UK, and many European countries. It was estimated to account for more than 25% of total sodium intake in several countries like UK, France, Belgium, and Turkey and up to 28% in Kuwait, and Lebanon (28%) (Quilez and Salas-Salvador, 2012; Brinsden *et al.* 2013; Al Hamad *et al.*, 2015; Al Medawar *et al.*, 2015). A recent study conducted by Al Jawaldeh and Al Khamaiseh (2018) showed that Lebanese Arabic Bread contains around 0.56g/100g of sodium on a wet basis. This contribution is of major concern in all countries as excessive sodium intake has been widely classified as a culprit nutrient in the development of many diseases like CVDs and hypertension. A reduction of dietary sodium around 1-3g/day can lead to major reductions in the number of people need antihypertensive therapy and deaths due to CVDs. For this reason, following the WHO initiatives and recommendations, a strategy consisting of gradual decrease in sodium in food has been implemented by many countries that are reformulating their food product to reach new sodium targets (Al Jawaldeh and Al khamaiseh, 2018; Al Jawaldeh *et al.*, 2019).

In Lebanon, the high consumption of bread is accompanied by a high exposure of NHC on this staple food. A study assessing the prevalence of claims among 354 Lebanese pre-packed bread, stated that 47.2% of these items carried non-nutrient claims, 32.5% nutrition claims and 15.3% health claims, with claims related to sugar, salt and fiber being the most commonly used. The same study reported that 49.8% (n=400) of supermarket shoppers check nutrition and health claims whenever purchasing bread (Khnaisser *et al.*, 2019).

Guidelines and standards for the nutrition and health claims are available in Lebanon. However, with the absence of regulatory framework regarding their control and surveillance, concerns are clear. In Lebanon, the recent findings of fraudulent claims of gluten-free labels raised skepticism about the credibility of other food labels present on highly consumed products. Bread is a staple food highly consumed in the Lebanese diet. The high consumption is accompanied by a high exposure and reliance on claims found on bread. There is a lack of studies in the area, assessing credibility of claims related to critical nutrients found in bread like sugar, fiber, protein and sodium. This study is the first of its kind in the Lebanon aiming to evaluate the compliance of nutrition claims on pre-packaged Lebanese bread based on CODEX and LIBNOR guidelines.

Chapter II

Nutrition Claims Credibility on Lebanese Bread: A Cross-sectional Study

2.1 Introduction

Chronic non-communicable diseases (NCDs), also known as chronic lifestyle-related diseases cause 71% of total deaths globally and are becoming increasingly significant causes of disability and premature death worldwide, along with both the human suffering and the socioeconomic harm they pose on a country (Bauer *et al.*, 2014; WHO, 2015).

Recognizing that, key components in the management of such diseases and their risk factors, are adopting healthier lifestyles and dietary choices (WHO, 2017a; 2017b; Sussman *et al.*, 2019), the demand of healthy products has increased, with a shift from the consumption of traditional products towards improved and altered versions (Siró *et al.*, 2008; Mitić and Gligorijević, 2015). In order to meet those changing consumer needs and global market development trends, producers and retailers are revising their strategies and developing new functional and healthier food products (Siró *et al.*, 2008). Moreover, as one of the most important measures in promoting healthy eating, food manufacturers, along with governments, are promoting nutrition labeling like nutrition and health claims (NHC), in order to help consumers in making informed decisions at the point-of-sale (Davidović *et al.*, 2014).

A claim is any statement made on a product suggesting that the latter has any special characteristic regarding its nutritional content, origin, composition or any other quality (CAC/GL 1-1979). Different types of claims can be found on food products. Health claims imply an association between a food and health. Nutrition claims convey information about specific nutritional

properties of the food. Subgroups of nutrition claims are: nutrient content claim intending to determine a certain level of a nutrient for example “low”, “high”, “source”; nutrient comparative claims comparing two or more products using words like “reduced” and “increased”; and non-addition claims pointing that an ingredient that is normally present in this food has not been added during production either directly and indirectly (CAC/GL 23-1997).

These claims are controlled by legislation to protect consumers from any fraudulent information. By law, a health claim should be formulated in a way that allows consumers to understand the beneficial effects of the product (EC-Regulation No. 1924/2006) but it should also reflect the real content of the product (CAC/GL-23-1997) (Salnikova *et al.*, 2014). The structure and content of a claim, the product category and consumer-related socio-demographic factors, level of trust as well as the implementation of regulations are major factors that play a significant role in consumer perceptions (Lähteenmäki *et al.*, 2010; 2013). In addition, those claims are perceived by some consumers as promotion tools, this raises skepticism about the truthfulness of the conveyed information (Mitić and Gligorijević, 2012). In fact, non-compliance of claims with the standards and guidelines have been reported in several developed countries like Canada, Australia, and Slovenia and UK (Korošec *et al.*, 2014; Pulker *et al.*, 2017; Franco-Arellano *et al.*, 2018; Grafenauer and Curtain, 2018; Sussman *et al.*, 2019), as well as in developing countries like Honduras and Malawi (Kasapila *et al.*, 2013; Santana *et al.*, 2019). Similar examinations conducted in the Middle Eastern countries were very far and few. In Lebanon, fraudulent gluten related labels were reported, whereas sodium related claims on bread (n=48), were found to be credible (Al Medawar *et al.*, 2015; Hassan *et al.*, 2017).

Bread is a staple food worldwide, providing a range of nutrients for its consumers, some of which are associated with health conditions like obesity, hypertension, like added sugar and salt, and others with several health benefits like fibers (Grafenauer and Curtain, 2018). In Lebanon, a high daily consumption of 136.8 g of bread (Al Medawar *et al.* 2015), is accompanied by a high exposure of NHC on this staple food, where 59.6% (n=354) carry at least one claim (Bou-Mitri *et al.*, 2019). The Lebanese Standards Institution (LIBNOR) has set guidelines and standards related to the use of NHC (NL 661: 2017). However, with the absence of regulatory framework regarding their control and surveillance, concerns are clear.

The aim of this study was to assess the compliance of nutrition claims on pre-packaged Lebanese bread with CODEX (CAC/GL -2-1985) and LIBNOR (NL 661:2017) standards, based on the nutrition facts values and nutrients analysis.

2.2 Materials and methods

2.2.1 Materials

All of the boric acid, potassium sulfate, methyl red, sodium hydroxide (NaOH), and sodium standard for the atomic absorption spectroscopy (AAS) were purchased from Sigma-Aldrich, Germany. Copper Sulfate and Methylene blue were from Fisher Chemical, India. Sulfuric acid (H₂SO₄) (95%) from Analar Normapur, France; acetone and octanol (99.5%) from Alpha Chimie, (France, cod. 120291). Deionized water was prepared using WaterPro system from Labconco (Kansas City, Missouri).

2.2.2 *Sample collection*

All bakeries producing Lebanese bread, and registered in Mount Lebanon at the Ministry of Industry in 2018 were visited for Lebanese bread assessment and collection.

Samples of all types of pre-packaged Lebanese bread available at the point-of-sale were collected (n=75) and clear pictures of both sides of the packets were taken (Grafenauer and Curtain, 2018).

Bread of different package sizes were account for only one sample.

All the information on the packaged bread were recorded, including the brand name, type of bread, type of grain, claims, availability of nutrition facts panel, and the displayed value of different nutrients (Grafenauer and Curtain, 2018; Sussman *et al.*, 2019). The different types of claims including nutrient content, non-addition, comparative, and health claims were classified based on CODEX standards (CAC/GL 23-1997) and LIBNOR (NL 661:2017).

The bread samples were kept in airtight sterile plastic bags and stored at -20°C until further analyses (Plácido *et al.*, 2012).

2.2.3 *Sodium analysis*

The sodium content was assessed following the reference method from the American Association of Cereal Chemists AACC 40-71 (AACC, 1999). For this purpose, 1 g of the bread sample was ashed for 12 h in a muffle furnace (Stuart Scientific, Great Britain), at 525°C. The ashed sample was cooled to room temperature in a dessicator. The total ash was dissolved in 10 mL HCl (1:1, HCl: H₂O), and heated until complete release of gases. The filtered samples (Filter paper, Fisherbrand, 90 mm, UK), were diluted in a 100 mL volumetric flask. A 0.5 mL aliquot of this solution was diluted with deionized water in a 50 mL volumetric flask (Plácido *et al.*, 2012).

Samples (n=24) were analyzed using the atomic absorption spectroscopy (AAS) (Agilent Technologies, 200 series AA 240 FS AA, Australia), equipped with a hollow cathode lamp for sodium ($\lambda=589$ nm). Quantification was performed using an external calibration curve, using sodium standard solutions of different concentrations (0, 1, 2, 3, 4 ppm). The analysis was conducted in quadruplets.

2.2.4 *Fiber analysis*

A total of 31 pre-packaged Lebanese bread samples carrying a claim related to fiber were analyzed for crude fiber determination, following the Association of Official Analytical Chemists (AOAC) Official Method 950.37 (LIBNOR NL 240:2010). Sample of 1 g was mixed with 0.9 g of celite. The mixture was then placed in the Fibertec™ machine (Fibertec 2010, FOSS, Denmark) where NaOH (1.25%) and 2-3 drops of octanol were added. After heating, the sample was cooled down for 30 min followed by washing with distilled water, H₂SO₄ (1.25%) and acetone (99.5% anhydrous). The residues were dried over 24 h under the fume hood, for 5 h in the oven (105°C), and weighed. The residues were then incinerated at 500°C for 5 h, using the muffle furnace and weighed. The quantity of crude fiber was estimated by difference in weight.

2.2.5 *Protein analysis*

Protein determination was carried out for 7 pre-packaged Lebanese bread samples following the AOAC 920.87 official method, using Kjeldahl principle (CXS 234-1999; AOAC, 1995, Chang and Zhang, 2017; Nielsen, 2017).). In this procedure, a digestion flask containing 1.5 g of sample, 7 g of potassium sulfate, 0.1 g of copper sulfate and 20 mL of concentrated sulfuric acid were placed in the Gerhardt apparatus (Gerhardt Classic Distillation Apparatus, Gerhardt Analytical Systems, Germany) for heating. When the digestion solution became clear, it was set to cool down

in an ice bath. Then, it was mixed with 300 mL distilled water and 70 mL NaOH (32%). The Kjeldahl flask was then connected to the distillation unit of the Gerhardt apparatus. After collecting 100-125 mL of distillate in the conical flask containing 2% boric acid and an indicator mixture (methyl red and methylene blue), the ammonia was titrated with 0.1 M HCl. The nitrogen in the sample was calculated using the conversion factor of 6.25.

2.2.6 Sugar analysis

Pre-packaged Lebanese bread samples carrying a sugar related claim (n=34) were tested using the AOAC 982.14 method. First, fat was extracted from 10 g of finely ground bread sample, using petroleum ether. Sugar was extracted from the fatless sample. Alcohol (100 mL) was added to the fatless sample. The mixture was then placed in a water bath at 80-85°C for 25 min. After cooling to room temperature, the extract was filtered through 0.45 µm syringe and set for liquid chromatography analysis. Sugar standard solution of sucrose, fructose, glucose and maltose were previously prepared and used to create the standard curve (AOAC, 2000).

2.2.7 Statistical analysis

All collected data were coded and analyzed using the IBM's Statistical Package for Social Sciences (SPSS) version 22 (IBM, Inc, Chicago, IL). Descriptive analyses were carried to assess the prevalence of different types of claims, claims related to different nutrients, availability of nutrition facts, and medians of different nutrient levels. In addition, descriptive analyses were used to assess compliance with claim criteria, that is, eligibility to make claims based on the nutrition facts and the nutrient analysis. Kruskal-Wallis test was used to assess the difference of nutrient levels between different types of bread. A p-value <0.05 was used for statistical significance.

2.3 Results and Discussion

2.3.1 Pre-packaged Lebanese bread sample characteristics

A total of 75 pre-packaged Lebanese breads were identified in all the registered bakeries in Mount Lebanon (Table 2.1). Of those, 29.3% were white, 21.3 % whole wheat, 18.7% brown, 17.3% bran, and 13.3% unconventional bread like quinoa, oat, almond and multi-cereal. Most of the collected Lebanese bread samples (88%) were made of wheat flour.

The prevalence of different types of breads containing functional ingredients like unconventional ones and those made of whole wheat and bran, highlights the efforts of bakery manufacturers, to line up with the changing consumers' needs and trends.

Table 2.1. Descriptive statistics for pre-packaged Lebanese bread sample (n=75) collected from bakeries across Mount Lebanon

Characteristics		n	%
Type of bread	White	22	29.3
	Whole wheat	16	21.3
	Brown	14	18.7
	Bran	13	17.3
	Other	10	13.3
Type of grain	Wheat	66	88.0
	Oat	5	6.7
	Other	4	5.3
Availability of NF ^a	Yes	35	46.7
	No	40	53.3
Having at least one claim	Yes	63	84.0
	No	12	16.0

^a NF stands for Nutrition Facts panel

2.3.2 Nutrient declaration and claims

Among the pre-packaged Lebanese breads collected, 46.7% (n=35 out of 75) had a nutrition facts panel available on the package and 50.8% (n=32 out of 63) had a claim without displaying a nutrition facts panel on the package (Figure 2.1). Nutrient declaration or nutrition facts panel, is a listing of nutrient content of a product. According to LIBNOR (NL 719: 2017) and Codex (CAC/GL 2-1985), nutrition facts is mandatory in all pre-packaged foods when they have a nutrition or health claim displayed on the package. Therefore, half of the Lebanese bread samples failed to meet the standard requirements. Similarly, failure to meet this requirement was also observed in Malawi, where 32.9% of products surveyed (n=316), had nutrition claims with no nutrition facts panels (Kasapila *et al.*, 2013). Moreover, since nutrition facts panels provide nutrition information, that are used by some consumers rather than claims to evaluate products, nutrition facts should be displayed on the package to help make product selections that suit their health conditions (Davidović *et al.*, 2014). In addition, carrying a nutrition facts panel will give more credibility to the claim and improve the manufacturer's ability to compete (FAO, 2016).

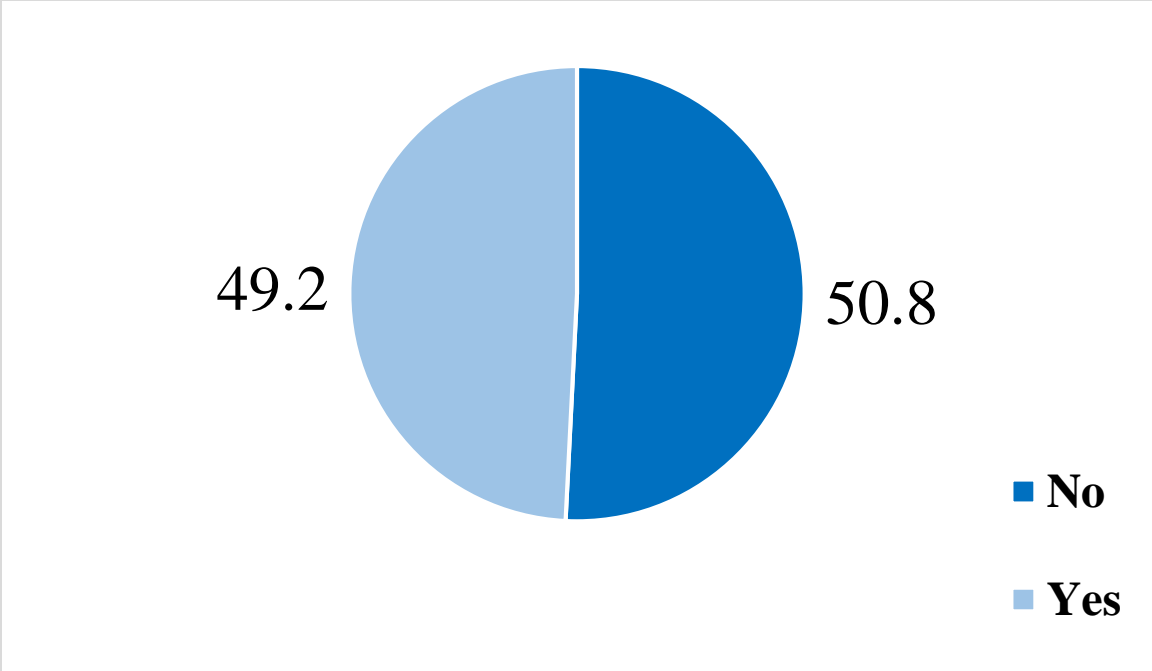


Figure 2.1 Availability of nutrition facts panel when a claim is displayed on pre-packaged Lebanese bread (n=35) in Mount Lebanon.

2.3.3 *Nutrients assessment based on the nutrition facts panel of different types of pre-packaged Lebanese bread (n=35) in Mount Lebanon*

Based on the information provided on the nutrition facts panel, the median and range of the main nutrients in different types of Lebanese bread were assessed (Table 2.2).

Table 2.2. Median and range of different nutrients according to the nutrition facts panel of different types of pre-packaged Lebanese bread (n=35) in Mount Lebanon.

Bread type	n	Median (Range)				
		Fiber (g.100 g ⁻¹)	Sugar (g.100 g ⁻¹)	Sodium (mg.100 g ⁻¹)	Protein (g.100 g ⁻¹)	Cholesterol (mg.100 g ⁻¹)
White	6	2.5(1.9-4) ^c	3.2(1.7-4.4) ^c	263.8(40.0-440.0)	8.5(6.7-10.0) ^e	0
Whole wheat	9	4.6(2.4-10.3)	0.3(0-3.3) ^d	233.0(0-464.3)	8.4(6.7-10.0) ^c	0
Brown	5	6.2(2.5-8.3) ^d	1.6(0-3.3)	254.4(80.0-314.2)	8.8(6.7-10.0)	0
Bran	6	6.1(2-13.9) ^d	0.1(0-2) ^d	119.0(0-479.4)	10.0(8.5-23.8) ^d	0
Other ^a	9	6.5(3.1-10.9) ^d	0.7(0-10.3)	243.9(47-300.0)	10.3(7.8-16.7) ^{d,f}	0
Total	35	4.8(1.9-13.9)	1(0-10.31)	249.2(0-479.4)	9(6.7-23.8)	0
<i>p</i> -value ^b		0.037	0.035	0.908	0.028	0.284

^a Other include breads labeled as quinoa, oat, multi-cereal, protein and almond

^b Kruskal-Wallis H test ($p < 0.05$)

Non-identical superscripts (c-d/e-f) indicate significantly different bread types

2.3.3.1 Fiber assessment in different types of pre-packaged Lebanese bread

Fiber content ranged between 1.9 to 13.9 g.100 g⁻¹ in the total bread category with a median of 4.8 g.100 g⁻¹. The unconventional types of bread like quinoa, oat, almond and multi-cereal, in addition to brown and bran bread were the richest in fibers with medians of 6.5, 6.2 and 6.1 g.100 g⁻¹, respectively, as compared to white (2.5 g.100 g⁻¹) bread (p=0.037). The dietary fiber content of cereals varies depending on cultivars, processing techniques, and botanical components (Sidhu *et al.*, 2007). The highest fiber content assigned to the unconventional bread as compared to white is mainly due to the fact that the average dietary fiber content for quinoa, oat and wheat bran were 10, 14 and 44%, respectively, whereas the milling process of wheat to make white flour used in white bread, results in a dietary fiber content of 2.5% (Sidhu *et al.*, 1999; 2007; Lamothe *et al.*, 2015). Moreover, according to the ingredient list available on the package, the unconventional types of Lebanese bread are made from composite flours such as a combination of whole wheat and oat flour, or had coarse bran added to the mixture, which might further explain the highest fiber content reported in this category. Knowing that those bread categories are the richest sources of fiber in Lebanese bread, their consumption is recommended for consumers seeking to prevent or mitigate certain conditions like CVDs, diabetes, obesity, constipation and colon cancer (Kaczmarczyk *et al.*, 2012; Baladrán-Quintana *et al.*, 2015).

2.3.3.2 Sugar assessment in different types of pre-packaged Lebanese bread

The sugar content in the different types of bread was assessed and it ranged between 0 and 10.3 g.100 g⁻¹. The results showed that white breads had the highest content of sugar with a median of 3.2 g.100 g⁻¹, whereas half of this amount was reported in brown bread (1.6 g.100 g⁻¹), and 1/10 in whole wheat (0.3 g.100 g⁻¹) (p=0.035). In addition, bran bread

recorded the lowest median of sugar with $0.1 \text{ g} \cdot 100 \text{ g}^{-1}$. Similarly, Grafenauer and Curtain (2018), reported lower sugar content in whole grain loaves compared to other loaf breads. Bread is a carbohydrate made from wheat flour with naturally-occurring sugars, with percentages varying depending on the extraction rate (Dewettinck *et al.* 2008). In addition, sugar is an ingredient used in several types of bread to enhance fermentation and sensory characteristics like flavor and color. Reducing sugars are main substrate of the Maillard reaction causing the darkening of the bread crust and its final color and taste (Barakat, 2015; Grafenauer and Curtain, 2018). Accordingly, high sugar levels could be added to white bread to improve the final product flavor and color. Likewise, the higher content of sugar in brown bread as compared to whole wheat bread might be due to the addition of brown sugar or caramel to improve the brownish color (Manohar *et al.*, 2018). Considering those results, the diabetic population is advised to go for whole wheat and bran bread.

2.3.3.3 Sodium assessment in different types of pre-packaged Lebanese bread

Sodium content in Lebanese bread ranged between 0 and $479.4 \text{ mg} \cdot 100 \text{ g}^{-1}$ with a median of $249.2 \text{ mg} \cdot 100 \text{ g}^{-1}$. The sodium content was the highest in white bread with a median of $263.8 \text{ mg} \cdot 100 \text{ g}^{-1}$, as compared to the other types of bread; however, the difference in sodium content between different types of bread is statistically insignificant ($p=0.908$). The Lebanese Action for Salt and Health (2014), reported that Arabic bread can consist of up to $500 \text{ mg} \cdot 100 \text{ g}^{-1}$ of sodium. Higher values were reported by Al Medawar *et al.*, (2015), where the average sodium content was $519 \text{ mg} \cdot 100 \text{ g}^{-1}$ in white pita bread and $579 \text{ mg} \cdot 100 \text{ g}^{-1}$ in brown pita bread. However, white French baguettes ones ($866 \text{ mg} \cdot 100 \text{ g}^{-1}$) had higher sodium content than brown ($821 \text{ mg} \cdot 100 \text{ g}^{-1}$) (Al Medawar *et al.*, 2015). Similarly, in Australia, white bread contained the highest in sodium content ($479 \text{ mg} \cdot 100 \text{ g}^{-1}$) as

compared to whole grain (400 mg.100 g⁻¹) and gluten-free (400 mg.100 g⁻¹) (p<0.0001) (Grafenauer *et al.*, 2018).

Differences in salt content in bread, which is a reflection of sodium was also reported in several countries. Barakat, (2015), observed differences in salt content between brown pita (1.5%) and white pita (1.3%), as well as white (2.2%) and brown baguette (1.9%) (Barakat, 2015). A study assessing mean salt content of bread in several countries across the Eastern Mediterranean region, showed that mean salt content of a sample of 10 Arabic white breads obtained from Lebanon (0.56%), were almost half of those reported in Tunisia (1.24%), Kuwait (1.10%), Oman (0.91%) and Bahrain (0.89%); but it was higher than that of Egypt (0.46%) and Jordan (0.43%) (Al Jawaldeh and Al Khamaiseh, 2018). In contrast, summarizing salt content in bread among European countries Quilez and Salas-Salvado, (2012) reported higher values in Turkey (1.82%), France (1.8%), and Spain (1.28%).

The wide range of sodium detected within the same type of Lebanese bread might be explained by the size of the bakery as large scale bakeries adopt automated processing techniques and standardized recipes, therefore, are not prone to adding more salt like local, small bakeries (Barakat, 2015). Therefore, it is suggested to set a standardized amount of salt that could be added to bread with relevant legislation developed to guide bakers (Al Jawaldeh and Al Khamaiseh, 2018).

Sodium is a critical nutrient that has been directly linked to elevated blood pressure, which is a major risk factor for cardiovascular diseases (CVD) (Al Jawaldeh *et al.*, 2019). Bread and bread like products ranked first among the major dietary sources of sodium in the Lebanese diet followed by processed meats and dairy products (26%, 12% and 9% respectively) (Al Medawar *et al.*, 2015). Lebanon was reported to have the highest sodium

intake for males with 4.8 g. person. day⁻¹ (Al Jawaldeh *et al.*, 2019). The dietary sodium intake for the total population was estimated to be between 2.9 g and 3.1 g per person per day, with 60% of adults exceeding the World Health Organization (WHO) recommendations of 2 g. day⁻¹ (Al Medawar *et al.*, 2015). Although 78% of Lebanese consumers recognize the association between salt and health, almost half were unaware that it may lead to stroke and CVDs, and only 44.7% were concerned about their sodium intake (Nasreddine *et al.*, 2014; Al Medawar *et al.*, 2015). Salt has several functions in bread production like enhancing flavor, texture, and yeast fermentation. Producers try to reduce the salt in bread without affecting its quality and provide information on the salt content on the package (Murniece *et al.* 2014). One of the challenges faced by bakeries in Lebanon, is the lack of a centralized mill, distributing the same flour to all bakeries. Getting flour from different sources with different qualities may result in the addition of salt to cover up for any reduction in functionality caused by the use of low quality flour (Al Medawar *et al.*, 2015).

2.3.3.4 Protein assessment in different types of pre-packaged Lebanese bread

The protein content was statistically the highest for the unconventional types of bread such as those labeled “protein-bread”, and those containing oat, quinoa and almonds, followed by bran bread with medians of 10.3 and 10.0 g.100 g⁻¹, respectively (p=0.028). Similarly, in Australia, whole grain breads were found to be statistically higher in their protein content as compared to white bread with medians of 7.5 and 6.0 g. serving⁻¹, respectively (p<0.0001) (Grafenauer and Curtain, 2018). Based on the ingredients list provided on the back-of-package, the unconventional breads with a high protein content were mainly made out of composite flour. Whether combined with oat, quinoa, or wheat, soy flour was always

present in these combinations. Containing up to 45% of protein and all essential amino acids (Taghdir *et al.*, 2016), the use of soy in composite flours is the main contributor to the high protein content recorded in those breads. Similarly, bran bread ranked second in its protein content among other types of bread, as it contains up to 15.5% of protein (Baladrán-Quintana *et al.*, 2015). In fact, bran is usually found in whole wheat and can also be added separately to the flour mixture. Bread with added fine or coarse bran can contain up to 12% protein (Sidhu *et al.*, 1999).

Apart from the high protein content which is of nutritional importance especially in developing countries where fortified wheat-based products are commonly used in response to the protein-calorie malnutrition present in those countries (Taghdir *et al.*, 2016; Zhou *et al.*, 2018), both soy and wheat bran have been reported to be rich in bioactive components association with a decreased risk of diabetes, carcinogenesis, and CVDs (Kotilainen *et al.*, 2006; Ahmad *et al.*, 2014; Baladrán-Quintana *et al.*, 2015, Taghdir *et al.*, 2016; Busnelli *et al.*, 2018).

2.3.4 Prevalence of claims on pre-packaged Lebanese bread in Mount Lebanon (n=75)

Table 2.3 showed that among the collected bread (n=75), 84% had at least one nutrition claim and 25% had a health claim. The breads also carried non-addition claims (70.7%), nutrient content claims (56.0%) and comparative claims (1.3%). The results also showed that almost all the unconventional (100%), whole wheat (93.8%), brown (92.9%) and bran breads (92.3%) had at least one nutrition claim, while 59.1% of the white had one claim. Moreover, 60% of the unconventional breads and almost one third of the whole wheat, brown and bran bread had a health claim, while none of the white presented these claims.

On the contrary, the use of nutrition and health claims was much higher than what was reported in Canada (46% and 1.5%, n=15286) (Franco-Arellano *et al.*, 2017), UK (29% and 15%, n=382) (Kaur *et al.*, 2015), Slovenia (37% and 13%, n=6342) (Pravst and Kušar, 2015), Serbia (6.6% and 6.3, n= 2138) (Davidović *et al.*, 2014), Ireland (47.3% and 17.8%, n=1880) (Lalor *et al.*, 2010), and five European countries (64% and 29% n=2034) (Hieke *et al.*, 2016). Moreover, this prevalence was higher than that of a previous study conducted in Lebanon, where among 148 pita bread collected in Mount Lebanon in 2017, 65.5% had at least one claim, 40.5% had a nutrition claim, and 16.9% had a health claim (Bou-Mitri *et al.*, 2019). This showed that the use of nutrition claim has doubled between 2017 and 2018 and the health claim use increased by 1.7 folds. Similarly, among nutrition claims, the observed prevalence of nutrient-content claims was higher than what was reported in several countries like USA (49.7%), Singapore (42.3%), Ireland (31.4%) and Latvia (15.7%) (LeGault *et al.*, 2004; Lwin *et al.* 2015; Lalor *et. al.*, 2010; Murniece *et al.* 2014).

This increase in the use of claims as well as the high prevalence of nutrition claims as compared to health claims observed in all other countries might be explained by the lack of governmental surveillance and improper regulations (Salnikova *et al.*, 2012; Al-Ani *et al.*, 2016). In addition, manufacturers might be taking advantage of the use of claims as strong marketing tool considering its effect to influence consumers' choice, leading to an increase in sales (Koen *et al.*, 2016). In fact, in Lebanon, consumers are highly influenced by claims at the point-of-sale, especially in the case of bread, where 49.8% of 400 consumers rely on claims when buying bread (Bou-Mitri *et al.*, 2019).

The high prevalence of claims on functional and unconventional bread as compared to the white bread, is in accordance with the literature. A study in Australia, showed that all

(n=48, 100%) breakfast cereals made of oats, and 97.5% (n=39/40) of those made of bran flakes, carried claims (Sussman *et al.*, 2019). Thus, in Lebanese bread as well as in other food categories, the higher prevalence of claims is found on products made with functional ingredients like whole grains, oat, quinoa and bran. In fact, research has shown that consumers have more positive attitudes towards claims carried by products with a pre-existing health image (Lähteenmäki *et al.*, 2010). Moreover, consumers who base their decisions at the point-of-sale, on nutrition information provided on the package, are less price sensitive than other consumers, and are more concerned about the healthiness of products (Sumanac *et al.*, 2013). Thus, manufacturers will benefit from the use of those claims on functional foods, in order to attract consumers who are actually willing to pay more for those products.

The nutrient content claims were related to sugar (45.3%), fiber (41.3%), salt (32%), cholesterol (16%) and protein (9.3%) (Figure 2.1). The results were similar to those reported in previous study on Lebanese bread, where the main claims found were also related to sugar (28.8%), salt (16.4%), fiber (14.7%), cholesterol (14.7%) and protein (2.3%) (Bou-Mitri *et al.*, 2019). Similarly, in Australia, the most common nutrient content claims used on bread were “low in sugar” (97%) followed by “a source of dietary fiber” claim (79%) (Grafenauer and Curtain, 2018).

Among non-addition claims, 62.7% (n=47) were related to the absence of preservatives, and were found on all types of Lebanese bread mainly white (25.5%) and whole wheat (21.3%) (data not shown). Similarly, Bou-Mitri *et al.* (2019) reported the use of such claims on all white bread. Preservatives are usually added to baked goods like bread to control molds, avoid spoilage and increase shelf-life. For this purpose, LIBNOR standards for

Lebanese bread allow the use of sodium/calcium propionate with a limit of 0.3% (NL 240:210). Such claims were also reported in Oceania (37.8%), Europe (16.7%) and North America (14.7%) (Lwin *et al.*, 2015). In the Pacific Islands, out of 1574 products, 194 stated not having a preservative added to the food (Snowdon *et al.*, 2013). The high use of “preservative-free” or “no added preservatives” claims on Lebanese bread might reflect the interest and concern of consumers about such ingredients. In Jordan, preservatives are perceived as an unknown personal and social risk (Al Rawad and Al Khattab, 2014). In Australia, preservatives are believed to be harmful to health (Williams *et al.*, 2004). Therefore, the increase use of non-addition claims could be in response to the increased concern of consumers, and their demand for products that have no preservatives. Accordingly, these claims on bread could be strictly used as strong marketing tools, as consumers will perceive the product to be more natural, healthy and of higher quality and thus affect their choice at the point-of-sale (Lwin *et al.*, 2015; Abou-Habib *et al.*, 2019). However, they might sometimes mislead consumers by disguising the use of other products that are harmful (Lwin *et al.*, 2015).

Table 2.3. Prevalence of different types of claims on different types of pre-packaged Lebanese bread (n=75) in Mount Lebanon.

Type of bread	n	Nutrition claims n(%)	Non-addition claims n(%)	Nutrient content claims n(%)	Comparative claims n(%)	Health claims n(%)
White	22	13(59.1)	12(54.5)	1(4.5)	0	0
Whole Wheat	16	15(93.8%)	12(75.0)	14(87.5)	0	5(31.3)
Brown	14	13(92.9%)	9(64.3)	8(57.1)	0	3(21.4)
Bran	13	12(92.3%)	10(76.9)	9(69.2)	1(7.7)	5(38.5)
Other*	10	10(100%)	10(100)	10(100)	0	6(60.0)
Total	75	63(84.0%)	53(70.7)	42(56.0)	1(1.3)	19(25.3)

* Other include breads labeled as quinoa, oat, multi-cereal, protein and almond

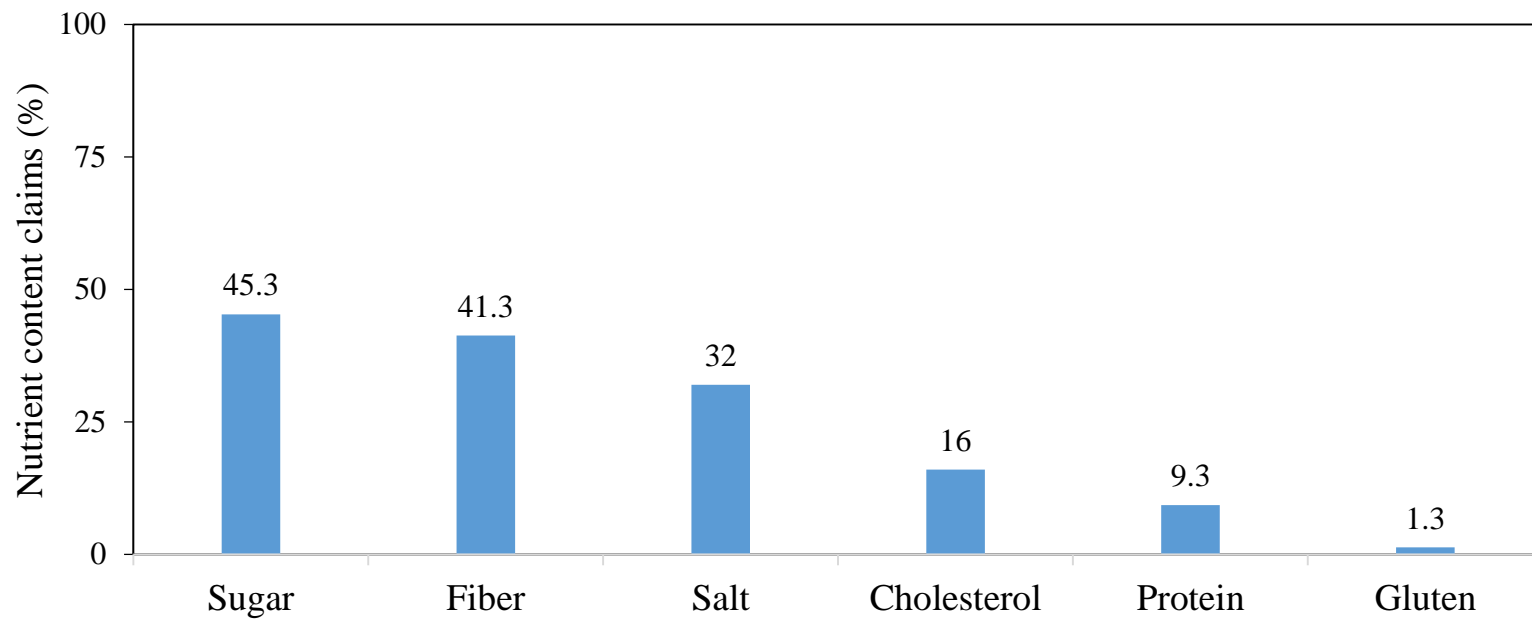


Figure 2.2. Prevalence of different nutrient content claims on pre-packaged Lebanese bread (n=75) in Mount Lebanon.

2.3.5 Compliance of salt claims on pre-packaged Lebanese bread in Mount Lebanon

Salt related claims on pre-packaged Lebanese bread (n=24) were examined for meeting claim criteria for sodium, based on values of the nutrition facts panel and nutrient analysis (Table 2.4). Based on the nutrition facts evaluation, all “free” (n=2, 100%), “very low” (n=1, 100%) and 42.9% (n=3 out of 7) of “low” claims referring to salt were compliant with the standards conditions. Based on the nutrient analysis, the only “very low in salt” claims and none of the 7 “salt free” claims were eligible to make the claim on the package. Similarly, 60% out of the 15 “low in salt” statements met claim criteria conditions. One pre-packaged Lebanese bread claimed the non-addition of salt, which is the absence of any ingredient that could contain sodium salts (CAC/GL 23-1997; NL 661:2017). No claim criteria conditions are defined by NL 661 (2017) or CODEX (CAC/GL 23-1997), to assess the compliance of such statements, however, based on the nutrient analysis, the median sodium content of this bread is 0.04 mg. 100 g⁻¹, matching the conditions of a “very low sodium” content.

In contrast to these results, a recent study, analyzing a sample of bread (n=48), commonly consumed in Lebanon including pita, French baguette, Tannour and Markouk, reported a mean sodium content of 127 mg.100 g⁻¹ in “low-salt” labeled breads, and the absence of sodium in “zero-salt” labeled breads, which indicates the credibility of those claims (Al Medawar *et al.*, 2015). In Slovenia, among 5104 food products assessed, none of the products within the bread, processed meats and cheese categories were eligible to make the sodium related claims found on the package (Korošec *et al.*, 2014). In Australia, 5% of 452 breads met claim criteria for “low in sodium” and 52 met the reformulation target of less than 400 mg. 100 g⁻¹ (Grafenauer and Curtain, 2018). Several studies reported bread as the

main salt contributor in the diet and salt reduction initiatives have been conducted to reduce and prevent NCDs (Al Medawar *et al.* 2015; Al Hamad *et al.* 2015). According to the National Institute for Health Care Excellence (2010), a reduction in salt intake of 1 g. day⁻¹ is sufficient to lower stroke and heart attack deaths by more than 7%. Regular consumption of low-sodium bread alternatives may lead to a decrease of more 0.6 g. day⁻¹, without major disruption of the diet (Daugirdas, 2013). In Lebanon, despite the reformulation of some products to have a lower salt content, only 38.3% of shoppers look for sodium labels on products in general (Nasreddine *et al.*, 2014) and 7% on pita bread (Bou-Mitri *et al.*, 2018). Al Medawar *et al.*, (2015), reported that 43.7% of consumers are affected by those claims at the point-of-sale and 38.6% purchase low salt alternatives. Given this evidence, bakeries should consider the interest of consumers in salt reduced products and their efforts in trying to decrease their salt intake to prevent or control medical conditions like hypertension. In fact, apart from increasing population awareness and education, one of the steps in sodium reduction initiatives is to monitor the compliance of industries (Al Medawar *et al.*, 2015). Therefore, provision of credible claims on the label is a must as sodium is a critical nutrient with serious health drawbacks. Government should be responsible for controlling sodium related claims to protect consumers. Bakers should also assess the credibility of claims on a regular basis. Moreover, apart from the need of adjusting the misleading assertions, bakeries are advised to help national salt reduction efforts. It is suggested not only to reformulate products for the population to have more low-salt alternatives, but also to use other front of pack labels like logos, which was implemented in by the WHO in several countries like Canada, Sweden, Denmark, in order

to draw consumers' attention and make it easier for them to distinguish healthy options (Trieu *et al.*, 2015).

Table 2.4. Percentage and count of pre-packaged Lebanese bread (n=24) in Mount Lebanon meeting claim criteria for sodium, based on values of the nutrition facts panel and sodium analysis

Claim on package	Conditions ^b (not more than)	Compliance based on NF ^d		Compliance based on analysis		Median (Range) (g.100 g ⁻¹)
		Claim & NF ^d n	Compliant n (%)	n	Compliant n (%)	
Free	0.005 g.100 g ⁻¹	2	2(100)	7	0	0.1(0-0.3)
Very Low	0.04 g.100 g ⁻¹	1	1 (100)	1	0	0.1
Low	0.12 g.100 g ⁻¹	7	3(42.9)	15	9(60.0)	0.1(0-0.5)
No Added ^a	n.d. ^c	1	-	1	-	0.04
Total	-	11	6(54.5)	24	9(37.5)	0.1(0-0.5)

^a cannot be assessed based on nutrition facts and analysis

^b eligibility conditions based on CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017)

^c n.d. not defined in CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017)

^d NF stands for nutrition facts panel

2.3.6 Compliance of fiber claims on pre-packaged Lebanese bread in Mount Lebanon

Fiber related claims (n=31) were evaluated for meeting claim criteria conditions based on nutrition facts panel and nutrient analysis (Table 2.5). The evaluation of the nutrition facts panel showed that all breads (n=4, 100%), claiming to be a “source of fiber”, and 66.7% (n=6 out of 9) of “high source of fiber” claims, were compliant. In contrast, the results of the nutrient analysis showed that 21.4 % of “source of fiber”, and 50% of the “high source of fiber” claims met claim criteria values. In addition, 12 had a “good source of fiber”; which is not defined neither in CODEX (CAC/GL 23-1997) nor LIBNOR (NL 661:2017) and there are no criteria values that could be used to evaluate the credibility of such claims. This claim is relevant in Australia, where it is defined as fiber content between 4 and 7 g per serving (Grafenauer and Curtain, 2018).

In Australia, an audit on fiber-related claims on bread revealed that the most credible claims were “source of fiber” with 54% of breads meeting claim criteria, followed by “good source of fiber” and “excellent source of fiber” with percentages of 37% and 8%, respectively (Grafenauer and Curtain, 2018). Another study, assessing credibility of claims on ultra-processed food products (n=215) in Australia, reported that 113 carried nutrient content claims, and among those claims, 11.4% (n=5 out of 44) “source of fiber”, and 12.5% (n=3 out of 24) of “high source of fiber” met claim criteria specified in the standards (Pulker *et al.*, 2017). In Honduras, among a sample of 144 functional foods, all cereal based products and 64% of baked goods met the criteria for “source of dietary fiber” and “high source of dietary fiber” claims, respectively. In addition, 43% of cereal bars, 29% of cookies and 8% of breakfast cereals were also eligible to make a “high fiber” statement (Santana *et al.*,

2019). In Toronto, Canada, 22% of breads (n=334), had fiber-related references on the label and 62% of breads met claim criteria for “source of fiber” (Sacco *et al.*, 2013). In addition, two thirds were eligible to make a claim but did not carry any reference to fiber (Sacco *et al.*, 2013). Moreover, 1.58% of breads were found to have fiber references using unregulated language like “multi-fiber” or “x grams of fiber”, but had a lower fiber content than breads with nutrient content claims (Sacco *et al.*, 2013). Consumers are not expected to have the ability to differentiate between the regulated and unregulated statements for them to make the right choice at the point-of-sale (Sacco *et al.*, 2013). Therefore, confused consumers will not get the higher amount of fiber they are trying to consume, thus, might not reach the recommended dietary fiber that will help them manage certain conditions like constipation. Fiber has long been promoted as a functional ingredient in food. Regular consumption of fiber, especially from cereal sources was associated with several health benefits like improved lipid profile, glucose metabolism, blood pressure control, weight regulation, and reduced risk of chronic inflammations (Ismaiel *et al.*, 2016; Królak *et al.*, 2017). Fiber claims and references found on bread packages are one of the ways manufacturers can communicate the presence of higher fiber content in the product to help consumers make healthier choices upon purchasing, especially that people are seeking such products and perceive them as healthier options (Hellyer *et al.*, 2012). In Lebanon, fiber claims ranked first among the nutrient content claims people actively look for upon purchasing with 36.8% of consumers showing interest in those claims (Bou-Mitri *et al.*, 2018). This might be related to the awareness and knowledge about the beneficial effects of fiber consumption. However, the high prevalence of fraudulent fiber claims found on bread raises concerns for consumers who are searching to increase their fiber intake due to

critical health issues like diverticulosis, constipation or type 2 diabetes (Królak *et al.*, 2017). The misleading claims present on the package, will not allow them to make informed decisions upon purchasing and may even prevent them for reaching their fiber intake goal, by tricking them into thinking they are getting more than the actual fiber content in the product. Thus, having credible claims on the package is essential for them to be able to make the right choice and improve their health. In addition, it has been reported that consumers are willing to pay more for bread with a higher fiber content due to its nutritive value (Hellyer *et al.*, 2012). As bread with functional ingredients like added fiber, has no regulations related to the price, policymakers should consider the use of misleading claims on bread packages as people are paying more for these products. In fact, the higher price of fiber fortified food along with the insufficient consumption of whole-meal products are some of the reasons, the average dietary intake of fiber is still way below nutrition recommendations in several populations (Królak *et al.*, 2017).

Table 2.5. Percentage and count of pre-packaged Lebanese bread (n=31) in Mount Lebanon meeting claim criteria for fiber based on nutrition facts values and fiber analysis

Claim on package	Conditions (not less than) ^b	Compliance based on NF ^c		Compliance based on analysis		Median (Range) g.100 g ⁻¹
		Claim & NF ^c n	Compliant n (%)	n	Compliant n (%)	
Source	3 g.100 g ⁻¹	4	4(100)	4	2(50)	1.4(0.8-1.8)
Good source ^a	n.d. ^a	9	0	12	0	1.9(0.5-3)
High source	6 g.100 g ⁻¹	9	6(66.7)	15	3(20)	1.8(0.3-4.2)
Total	-	22	10(45.5)	31	5(16.1)	1.8(0.3-4.2)

^a n.d. not defined in CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017)

^b eligibility conditions based on CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017)

^c NF stands for nutrition facts panel.

2.3.7 Compliance of protein claims on pre-packaged Lebanese bread in Mount Lebanon

Protein claims (n=7) were evaluated for meeting claim criteria based on the nutrition facts panel and nutrient analysis (Table 2.6). Assessments using both methods, that is, nutrition facts and protein analysis, showed that all “source of protein” (n=3, 100%), and “high source of protein” (n=4, 100%) claims, met claim criteria conditions. Thus, all references related to proteins were credible.

In Australia, an audit on bread, showed that 78% of 243 loaf breads, and 57% of total breads (n=354) were a “source of protein” (Grafenauer and Curtain, 2018). Protein functional foods have recently gained popularity among the Lebanese population where their market has reached 28.3% of consumers, especially males and those going to the gym (Chammas *et al.*, 2019).

The credibility and compliance of protein-related claims on pre-packaged Lebanese bread are due to the proper formulation of those products, that is, the use of high protein components like soy flour, bran, and quinoa as indicated in the ingredients lists. However, bakeries should sustain the use of such mixtures that provide the high protein content. In addition, claims should be controlled by governments and bakeries, to monitor a sustainable compliance with the standards.

Table 2.6. Percentage and count of pre-packaged Lebanese bread (n=7) in Mount Lebanon meeting the claim criteria for protein based on nutrition facts panel values and protein analysis

Claim on package	Conditions (not less than) ^a	Compliance based on NF ^b		Compliance based on analysis		Median (Range) g.100 g ⁻¹
		Claim & NF ^b n	Compliant n (%)	n	Compliant n (%)	
Source	3 g.100 g ⁻¹	3	3(100)	3	3(100)	13.3(12.7-13.6)
High source	6 g.100 g ⁻¹	4	4(100)	4	4(100)	17(12.9-37.2)
Total	-	7	7(100)	7	7(100)	13.3(12.7-37.2)

^a eligibility conditions based on CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017).

^b NF stands for nutrition facts panel.

2.3.8 Compliance of sugar claims on pre-packaged Lebanese bread in Mount Lebanon

Sugar free claims on the Lebanese bread were 91.7% (n=11 of 12) and 61.5 % (n=16 of 26) compliant based on the nutrition facts evaluation and the nutrient analysis, respectively (Table 2.7). Other sugar related claims including “reduced in sugar” (n=1) and “no-added sugar” (n=5) and “low in sugar” (n=2) were all ineligible as they were not defined neither in CODEX (CAC/GL 23-1997) nor in LIBNOR (NL 661:2017). In Australia, 90% of breads met the criteria for “low in sugar” claim (Grafenauer and Curtain, 2018). In Slovenia, bread and bakery products were ranked among the top three food categories with the highest amount of total sugars; however, the mean sugar content was lower in products carrying nutrition claims or health claims, as compared to those without any claim (Kupirovič *et al.*, 2019). Sugar is a critical nutrient that has been associated with weight gain, obesity, cardiovascular diseases, and dental caries (Bernstein *et al.*, 2016). Bread is a carbohydrate made from wheat flour with naturally-occurring sugars, with percentages varying depending on the extraction rate (Dewettinck *et al.*, 2008). Although some bakeries avoid adding sugars to suit the diabetic and obese population, other bakers add sugar to their mixture, in order to enhance color, flavor and yeast fermentation (Dewettinck *et al.*, 2008; Barakat, 2015; Grafenauer and Curtain, 2018). People are aware of the sugar-disease relationship and attribute health benefits to products with sugar related claims (Hughes *et al.*, 2013). In Lebanon, a recent study reported that, 27.6% out of 400 consumers look for “no sugar added” claims on bread (Khnaisser *et al.*, 2019). This high interest in those claims might be attributed to the increased awareness of the Lebanese population about excessive sugar consumption and its drawbacks (Khnaisser, 2019). Fraudulent statements related to sugar content might severely affect people with certain medical conditions like diabetics;

especially in Lebanon where diabetes ranked fourth among the leading causes of death and 12.2% of Lebanese adults were estimated to have the disease (Hilal and El-Jardali, 2016). Such data might be even an underestimate of the true prevalence due to the large proportion of underreporting and undiagnosed diabetics (Hilal and El-Jardali, 2016).

Moreover, since bread naturally contains sugar, it is suggested to replace “sugar free” claims by “no-added sugars”. It is practically impossible to differentiate free and added sugar using chemical analyses. With all the recommendations, policies and initiatives regarding limiting sugar intake such baseline information should be provided by bakeries, for their consumers to make informed decisions (Bernstein *et al.*, 2016). In Australia, added sugars have been reported to be one of the reasons people avoided bread in 2017 (Grafenauer and Curtain, 2018). In Sweden, 10% (n=1134) described healthy bread as one with reduced sugar content (Sandvik *et al.*, 2018). In UK, among 367 participants, 93.7% reported checking “no added sugar” claims and 81.7% “reduced in sugar” claims. Moreover, although products bearing the first claim were perceived as more natural and less processed than the sugar reduction statements, all participants expected the presence of sugar in products labelled “no added sugar” and assumed that the non-addition statement refers to sucrose rather than total sugars (Patterson *et al.*, 2012). Similarly, a survey in New Zealand, revealed that 72% (n=1525) of participants correctly assumed that products with “no added sugars” labels could contain natural sugars, but low income shoppers frequently misinterpreted such claims (Gorton *et al.*, 2010). In Lagos, Nigeria, a study assessing knowledge about food labels information found that, 42.1% of participants (n=420), knew that sugar is one of the nutrients that should be reduced in a product and 25.2% were concerned about sugar content when reading labels (Olatona *et al.*, 2019). In Lebanon, the

high exposure to sugar claims on Lebanese bread, along with the high prevalence of dishonesty of these claims leading to deluded consumers, and the effects attributed to high sugar intake, industries are urged to provide more information on their packages. For example, similar approaches to USA can be followed like providing information on intrinsic and added sugar on the nutrition facts.

Table 2.7. Percentage and count of pre-packaged Lebanese bread (n=34) in Mount Lebanon meeting the claim criteria for sugar based on values of the nutrition facts panel and sugar analysis

Claim on package	Conditions ^c (not more than)	Compliance based on NF ^d		Compliance based on analysis		Median (Range) (g.100 g ⁻¹)
		Claim & NF ^d n	Compliant n (%)	n	Compliant n (%)	
Free	0.5 g.100 g ⁻¹	12	11(91.7)	26	16(61.5)	0.5(0.5-4.3)
Low ^a	n.d. ^b	1	-	2	-	0.5
Reduced ^a	n.d. ^b	1	-	1	-	2.6
No added ^a	n.d. ^b	5	-	5	-	0.5(3.4-0.5)
Total	-	19	11(32.4)	34	16(47.0)	0.5(0.5-4.3)

^a cannot be assessed based on nutrition facts and analysis.

^b n.d. not defined in CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017).

^c eligibility conditions based on CODEX (CAC/GL 23-1997) and LIBNOR (NL 661:2017).

^d NF stands for Nutrition facts panel.

2.3.9 Compliance of cholesterol claims on pre-packaged Lebanese bread in Mount Lebanon

Among the collected samples, 16.0% (n=12) claimed the absence of cholesterol in their products. Cholesterol is a fat-like substance found in all cells of the body and mainly produced by the liver in humans and animals. Dietary cholesterol, which is the cholesterol present in food, can only be found in animal products like meats, poultry, eggs, shellfish and dairy products like cream, and milk. Plant food like beans, fruits, and vegetables are naturally free of cholesterol (FDA, 2018). Eligibility criteria for cholesterol claims requires the product to have a cholesterol content of no more than 0.02 g.100 g⁻¹ for “low cholesterol” and no more than 0.005 g.100 g⁻¹ for “cholesterol-free” claim. In addition, qualifying food products for both claims must contain less than 1.5 g.100 g⁻¹ of saturated fat (CAC/GL 23-1997; NL 661:2017). Out of the 12 Lebanese breads claiming to be “cholesterol-free”, 11 (91.7%) exhibited a null value for cholesterol in the nutrition facts panel making them eligible to make the stated claim. In 2001, a survey on food labels, conducted by the Center for Food Safety and Applied Nutrition (CFSAN) of the Food and Drug Administration (FDA) revealed that 4.5% of products in the United States had claims related to cholesterol. The main food products carrying such claims were crackers (64.6%), eggs and egg substitutes (56.4%), butters and margarines (55.1%), meat/poultry (36%) and shortenings and oils (27.1%) (LeGault *et al.*, 2004). All these items were animal products and could carry such claims to inform consumers about possible alterations in cholesterol contents for a healthier choice. Cereals and breads are not a source of cholesterol, unless milk, butter or eggs were used in the recipe. For example, pan bread contains butter, while Scandinavian rye bread contains butter, milk and eggs among its ingredients (Barakat,

2015). The Lebanese national standards listed milk as an optional ingredient that could be added to the Lebanese Arabic bread (NL 240:2010). For example, milk powder might be used to enhance crust color (El-Khoury, 1999). However, in the case of Lebanese bread, the standard recipe adopted by all bakeries in Mount Lebanon, includes flour, salt, yeast, sugar and water. Functional ingredients that are added to Lebanese bread like soy flour, quinoa, oats and bran are also plant based and may even lower cholesterol levels in the body. Since, none of these ingredients are animal products, pre-packaged Lebanese bread does not contain any possible source of cholesterol. Therefore, although “cholesterol-free” claims on pre-packaged Lebanese bread could be considered credible based on the eligibility criteria, their presence is considered misleading and purely displayed for marketing purposes. Consumers will be tricked into buying products with these claims as they will be perceived as healthier options. However, there is no need to make such statements when the product is not a source of dietary cholesterol. In addition, one of the conditions demanded by national and international standards for claiming the absence of a certain ingredient, is that the latter should be normally expected to be found in the product (CAC/GL 1-1979; NL 660:2017). In order to be more credible towards consumers, it is suggested to remove “cholesterol-free” claims on pre-packaged Lebanese bread, or replace them by more truthful statements such as “naturally free from cholesterol”. In Honduras, out of 144 functional foods, all sweetened juices, baked products and sweetened cereals stating to be cholesterol free, were eligible to make such claim. Similarly, 86% of cereal bars, 71% of cheeses and 71% of cookies met the criteria of this claim, in contrary to meat products which presented a high content of cholesterol and could not state to be “cholesterol-free” (Santana *et al.*, 2019). In Lagos, 63.3% of people were aware that

cholesterol should be reduced in food and 31.4% were concerned about this nutrient when reading labels (Olatona *et al.*, 2019).

2.3.10 Standard of identity compliance

Pre-packaged bread samples meeting crude fiber criteria of the “Lebanese bread standard of identity” were assessed (Table 2.8). Out of 14 brown breads, 5 were analyzed for crude fiber and 60% met the conditions specified in LIBNOR (NL 240:2010). As for bran bread, 7 out of 13 samples were analyzed and 57.1% of those samples were compliant with the standard of identity of bran bread. These results, highlight the need to reassess crude fiber content by bakeries, as their non-compliance with the standard of identity requires changing the name of the product.

Table 2.8. Percentage and count of pre-packaged Lebanese bread meeting crude fiber criteria of the Lebanese bread standard of identity

Bread type	n	Conditions (%) ^a	Compliance based on analysis	
			n	Compliant n (%)
Brown	14	≥1.5	5	3(60)
Bran	13	≥2	7	4(57.1)

^a eligibility conditions based on LIBNOR (NL 240:2010)

2.3.11 Limitations

This study has potential limitations, as the reported findings are not representative of all claims presented to Lebanese consumers as only one food category was assessed. However, bread was audited as it is a Lebanese staple food, that is likely to have a high prevalence of claims. Therefore, issues reported in this study may occur in other food categories as well. In addition, the bread was only collected from bakeries located in Mount Lebanon, and did not cover other governorates. However, most of those bakeries have several branches across Lebanon and sell their products in large supermarkets. Thus, it can be

assumed, that the results were sufficient to highlight the misuse of claims, and the need for control and surveillance.

2.4 Conclusion

The overall findings show that there's a high prevalence of non-compliant claims on pre-packaged Lebanese bread in Mount Lebanon. Except for protein related claims, a large proportion of nutrient content claims related to salt, fiber, and sugar did not meet claim criteria whether based on nutrition facts evaluation or nutrient analysis.

The high exposure to those inaccurate claims found on a staple food in the Lebanese diet, along with the health drawbacks of excessive intake of some of its major nutrients like salt and sugar highlights the need for more stringent regulations related to the use of NHC. A legal framework is required to guarantee that nutrient content claims are based on scientific evidence, in order to protect consumer from excessive critical nutrients that may jeopardize their health. Education is also required to increase consumers' knowledge about food labelling and ensure their ability to correctly interpret nutrition information on the package, and make informed decisions at the point-of-sale. In the absence of supervision on the compliance of claims, further studies should focus on evaluating the prevalence of claims food with poor nutritional quality as consumers may perceive them as healthy.

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No potential conflict of interest was reported by the authors.

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Declaration of interest

Conflict of interest: none.

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