STUDY ON THE COMPLIANCE OF NUTRITION LABELS ON PREPACKAGED FOOD ACCORDING TO LOCAL AND INTERNATIONAL GUIDELINES

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FACULTY OF SCIENCE
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ABSTRACT

Nutrition information on food labels acts as a conduit for food producers to convey related information to consumers. Nutrition labels are available on mostly all prepackaged foods in the market. Some researches showed that credible nutrition labels for consumers are able to assist consumers in making a healthier choice. The objectives of this study are to investigate the accuracy of nutrition label at prepackaged foods in Malaysia and how many prepackaged foods do not comply with the local and international guidelines. Another objective is to study the current enforcement practice for nutrition labelling regulations in selected hypermarkets and government's authority in this matter. The present study consists of 100 samples which have been stratified into eight categories which are prepared cereal food; milk and dairy products; flour confection; canned meat, fish and vegetables; canned fruit and various fruit juices; snacks and indulgence food; coffee, tea and other beverages; and spread. Laboratory analysis has been carried out to determine the content of energy, fat, carbohydrate and protein in the samples. The analytical values are compared with the declared values by referring to the guidelines, in order to determine the percentage of compliance. Additionally, interview sessions with person in charge from both the government and private sectors are conducted to get information about common practice of surveillance of nutrition labelling accuracy. The results have shown that 34% of analysed products do not comply with the tolerance limit according to the Food Act 1983, Malaysia (one-way approach tolerance limit). Moreover, 73% of the products failed to comply with the tolerance leeway ± 20% (two-way approach) and 56% of products do not comply with the tolerance limits set in Local Authority Coordinator Regulatory Services (LACORS). Canned meat, fish and vegetables illustrated the worst percentage of compliance among all food categories, in other words protein demonstrated the highest percentage of non-compliance. Based on the interview sessions, there is no specific practice to ensure the

accuracy of the nutrition labels on the packaged food sold in the markets. The poor accuracy of nutrition label on prepackaged food based on this study requires reassessment by the manufacturers. It is also suggested, an enforcement unit to be set up and conduct unscheduled surveillance on the accuracy of nutrition label as a trustworthiness control. In addition, food manufacturers can also send their products to accredited laboratories to get more accurate and precise nutrition information. The government may give tax relief for food manufacturers on this analytical service cost. Consequently, consumers will be able to gain credible food products. Lastly, further investigation regarding the accuracy of other nutrients such as sodium, trans fat, contents of nutrients or minerals which have been declared on the package food must also be tested in future studies.

ABSTRAK

Maklumat nutrisi pada label produk makanan merupakan saluran bagi pengeluar makanan untuk menyampaikan informasi berkaitan kepada pengguna. Maklumat nutrisi boleh didapati pada kebanyakan makanan berpaket di pasaran. Kajian lepas menunjukkan label nutrisi dipercayai dapat membantu pengguna membuat pilihan yang lebih sihat. Objektif kajian ini adalah untuk mengkaji ketepatan maklumat nutrisi pada makanan berpaket di Malaysia dan berapa banyak makanan berpaket yang tidak mematuhi garis panduan tempatan dan antarabangsa. Objektif seterusnya adalah untuk menilai aktiviti penguatkuasaan dalam memantau kepatuhan label nutrisi yang melibatkan pasar raya terpilih dan pihak kerajaan berautoriti. Kajian ini melibatkan 100 sampel makanan berpaket yang telah dibahagikan kepada lapan kategori iaitu makanan berbijirin; susu dan produk susu; makanan berasaskan tepung; daging, ikan, sayur yang ditin; buah-buahan dan minimum tin; makanan ringan, kopi, teh dan minuman; dan makanan yang disapu. Analisa makmal telah dijalankan untuk mengenal pasti kandungan tenaga, lemak, karbohidrat dan protein di dalam sampel. Perbandingan antara keputusan analisis makmal dan nilai nutrisi yang diisytiharkan pada label makanan berpaket dilakukan untuk mengetahui peratusan kepatuhan mengikut garis panduan yang ditetapkan. Sesi temuduga diadakan dengan pegawai berkaitan dari sektor kerajaan dan swasta untuk mendapatkan maklumat mengenai amalan pemantauan terhadap ketepatan label nutrisi. Hasil kajian mendapati 34% sampel tidak mematuhi had toleransi berpandukan Akta Makanan 1983, sebanyak 73% sampel makanan gagal mematuhi had toleransi berdasarkan panduan pendekatan dua hala (leeway ± 20%) dan sebanyak 56% gagal mematuhi had toleransi yang ditetapkan oleh *Local Authority Coordinator Regulatory Services (LACORS)*. Daging, ikan dan sayur ditin menunjukan kadar kepatuhan yang paling tidak memuaskan diantara semua kategori

makanan dengan kata lain protein menunjukan peratus ketidakpatuhan paling tinggi. Berdasarkan sesi temuduga yang dijalankan, tiada amalan tertentu dilakukan untuk memastikan ketepatan label nutrisi pada makanan berpaket yang dijual di pasaran. Ketepatan maklumat nutrisi pada makanan berpaket berdasarkan kajian ini adalah tidak memuaskan dan memerlukan penilaian semula oleh pengusaha. Adalah dicadangkan supaya suatu unit penguatkuasaan ditubuhkan untuk melaksanakan pemantauan secara tidak berkala bagi tujuan pemeriksaan produk makanan yang ada di pasaran. Selain itu, pengeluar makanan patut mendapatkan perkhidmatan analisa dari makmal yang berakreditasi untuk mendapatkan nilai nutrisi yang tepat. Kerajaan boleh mewujudkan potongan cukai kepada pengeluar makanan yang mengambil inisiatif tersebut. Justeru, pilihan yang tepat daripada fakta nutrisi yang dipercayai dapat dilakukan oleh pengguna. Akhirnya, kajian lanjut mengenai ketepatan nutrisi lain seperti natrium, lemak trans, penentuan kandungan nutrien atau mineral yang lain yang dipaparkan di atas label turut perlu dianalisa untuk mengetahui ketepatannya untuk kajian akan datang.

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LIST OF SYMBOLS AND ABBREVIATIONS

AOAC	Association of Official Analytical Chemists
BOP	Back of pack
CVD	Cardiovascular diseases
DPAH	Diet, Physical Activity and Health
EPF	Employees Provident Fund
FD&C	Federal Food, Drug and Cosmetic Act
FDA	Food and Drug Administration
FOP	Front of pack
FSAI	Food Safety Authority of Ireland
FSIS	Food Safety and Inspection Service
FSQ	Food and Safety Quality Division
GDA	Guideline daily amount
GDP	Gross Domestic Products
Kcal	Kilocalories
LACORS	Local Authorities Coordinators of Regulatory Services
MIDA	Malaysian Investment Development Authority
MOH	Ministry of Health Malaysia
NCD	Non-communicable diseases
NLEA	Nutrition Labeling and Education Act
NSPNCD	National Strategic Plan for Non-communicable Diseases
RPD	Relative percentage difference
RSD	Relative standard deviation
USDA	U.S. Department of Agriculture
WHA	World Health Assembl
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

Nutrition label is a panel found on food packaging which contains a variety of information on the nutrition value of the food item. There are many pieces of information which are standard on most food labels, including serving size, number of calories, grams of fat, including nutrient and list of ingredients. This information helps people who are trying to restrict their intake of fat, sugar, sodium and other ingredients, or for those individuals who are trying to optimize their intake of healthy nutrients such as calcium or vitamin C. The label provides each item with its approximate percentage of daily value, generally based on 2000 kcal. Therefore nutrition label is acting as a conduit to convey information related to the content of prepackaged food from food manufacturers to consumers.

Other than acting as a communication tool, food manufacturers are using nutrition label as a tool to enhance their products profile where they can highlight the nutritional qualities of their products and let consumers to discern that from competitors. Food manufacturers can enlarge the nutritional values of their products as health claims to draw consumers' attention as this can strike a chord among consumers. This can allow food manufacturers to use nutrition label as a springboard for sales and marketing promotion.

Nutrition label is also undertaking a crucial role on free trade activity. The international trade barriers are less complicated comparing to olden days but regulations and guidelines of nutrition label should be abided for food safety and health purposes. Some countries require mandatory nutrition label on all prepackaged food whereas some are based on voluntary basis. The guidelines of tolerance limits for nutrition label are different for some countries as well, therefore this is important for food manufacturers to provide accurate nutrition label so that they will have no problem to export their products to all countries.

The accurate nutrition label can increase competitiveness strength of the products. An exporting product which is giving misleading nutrition label will tarnish the export country's reputation. This is because a products' origin country is representing the country, the misleading of information on nutrition label reflecting that the slackness of the enforcement practice in the country indirectly.

A French philosopher, Anthelme Brillat Savarin once said "*Dis-moi ce que tu manges, je te dirai ce que tu es*", which means tell me what you eat, and I will tell you what you are (Brillat-Savarin, J. A., 1853). This statement is so true, by looking at the number of the patients who are suffering from non-communicable diseases (NCD) nowadays.

Non-communicable diseases (NCD) refers to diseases that are not infectious, neither caused by bacteria nor viruses. This is normally caused by diet intake. The most common NCD are cardio vascular diseases, type II diabetes, certain types of cancer, obesity, hypercholesterolemia and hypertension (Tee, 2014).

Since the beginning of the 20th century, worldwide shows drastic demographic changes due to World War I and II, epidemic diseases like acquired immune deficiency syndrome (AIDS) or other contagious diseases like severe acute respiratory syndrome (SARS) or the current Ebola cases. During this period, malnutrition also plays a role in the demographic change. Today, coronary heart disease becomes a leading killer in the world. One-third of deaths are caused by cardiovascular diseases (CVD), and 60% of all mortality is attributed to NCD (Pekka et. al., 2002).

Globally, obesity has become a pandemic with prevalence statistics escalating rapidly among many levels of society in both developed and developing countries (Prentice, 2006). In Malaysia, the numbers of obese citizens have increased to 250% from year 1996 to 2006 (Zhang, 2014). Then reports from National Strategic Plan for Non-Communicable Disease (NSPNCD) showed dramatic increase of hypertension and diabetes at 43% and 88% respectively in the same period of year. This situation became worse when WHO reported that diabetes patients have reached 2.6 million in the year of 2011 whereas the prediction of WHO on the number of diabetes patients in Malaysia are 2.48 million in year 2030; unfortunately diabetes patients in Malaysia have exceeded WHO prediction (Zhang, 2014).

And this is why, it is imperative to know the intake of nutrients into our body. In this case, would not nutrition label is playing a vital role in informing consumers on this matter?

Relating to this, Malaysia has introduced some policies and strategies such as National Plan of Action Nutrition of Malaysia (NPAMN) on how to cope with NCD issues. Activities such as reviewing of the nutrition labeling regulation, educate consumers on food labeling and inject consumer awareness on food labeling are planned in NPAMN. These were discussed on Tenth Malaysia plan as well. Food Act 1983 and Regulations 1985 is another strategy to maintain a healthy nation by implementing and controlling the regulation related to food and nutrition labeling. Therefore, this research is aiming to investigate whether these policies and regulations are effectiveness executing.

1.1 Problem Statement

Human's health is related to diet. As the study conducted by Prieto-Castillo et al., (2015), NCD such as obesity, diabetes, cardiovascular diseases and cancer represent the number one worldwide cause of mortality and global burden of diseases. These diseases are related to diet. For instance, prevalence of hypertension always associated to sodium intake in the diet (Alkalaf et al., 2015, Aburto et al., 2013, Forman et al., 2012, Batis et al., 2013, Graudal et al., 2014), obesity risk and type II diabetes are associated with sugar intake (Malik et al., 2012, Johnson et al., 2013, Gulati et al., 2014), coronary diseases and mortality are associated with intake of trans-fatty acid (Willett et al., 1993, Oh et al., 2003, Kiage et al., 2013) and cancer also caused by excessive intake of high fat or low fiber food (DeClerck, 2016, Kroenke et al., 2013, Day et al., 2013, Hansen et al., 2012). Therefore, consumers should aware of the intake of nutrients either from fresh or prepackaged food to avoid pestering of ailments. At the same time, the nutrition label on prepackaged food should be reliable to protect consumers' health.

Aforementioned earlier, NCD issue is a burden towards the country. A patient who is suffering from NCD may need to take medical leaves so often, this can affect his performance and eventually this will reduce the company's productivity. This will directly emerge a ripple effect to the country.

According to news report from Malaysian Journal of Nursing Online News Portal (MJNeNews) on December 2012, Malaysia could confront a potential shortfall in healthcare financing of US$ 4.1 billion (RM12.46 billion) in 2020, which will require additional fiscal spending. Citizens may need to bear higher out-of-pocket funding in term of money from insurance, employees provident fund (EPF) or their own saving when our country reduces the medication subsidiaries. In the report also stated that, the total healthcare cost in the country is projected to rise by 8.8% yearly to US$ 25.8 billion by 2020. Therefore this is imperative that consumers to maintain a healthy life style by choosing the healthy diet. Productivity of the country will be increased and eventually increase the country's revenue.

According to a report from Malaysia-German Chamber of Commerce and Industry (MGCC AHK) which was generally discussed about the market watch of food industry in Malaysia for year 2012. In the report stated that the Malaysian food and beverage market is becoming increasingly sophisticated and is supplied by both local and imported products, especially nutrition fortification processed food. Lifestyle changes and increasing of consumer awareness in nutrition value has created demand for healthier prepackaged food (Tarabella et al., 2012).

On top of that, there are nearly 3,200 manufacturers involved in the food manufacturing industry in Malaysia and the industry accounts for nearly 10% of Malaysia's manufacturing output. Processed foods are exported to 80 countries, with an export value in 2010 of more than US$3.8 billion (MCGG AHK Report, 2012). Among 3,200 manufacturers, 80% were small and medium enterprises. The numbers of small and medium size manufacturers in food industries has reached 6000 at the year 2015. The increment of the number of food manufacturing also due to the consumers' lifestyle changes, increasing of household income and rising of the urban population raises the demand of convenient foods or prepackaged foods (GAIN Report, 2015). Therefore, accuracy of the nutrition information of food label is critically important.

Aforementioned earlier, Malaysian products are exported to 80 countries. Different countries will have their own guidelines and regulations for import purpose. Food manufacturers should aware about that and let their products to put on shelf successfully at the importing countries. Our own country does have Food Act 1983 and Regulations 1985 as a guideline for food manufacturers to refer. Food manufacturers should always put effort to comply with the regulations. However, there may have some irresponsible food manufacturers who are unwilling to abide to the regulations, especially small and medium entrepreneurs (SME) who may not have professional staffs in their organization to execute jobs related to rules and regulations on food labeling. Then whether the enforcement unit in the country is effectively executing the regulations correlate to this issue?

1.2 Research Questions

Rapidly increasing of NCD is a serious threatens towards a country. As mentioned earlier, the prevalence of NCD patients in a country will reduce the productivity and GDP of the country. Therefore this is important to ensure that all citizens are taking care of their diets to avoid to become the victims of the NCD and affect the economical growth of the country.

From the study of Campos, 2011 on the review of nutrition labeling, she found that consumers attended the used of nutrition labels on prepackaged food was generally high. Therefore the information of the nutrition label must be précised and accurate by not mislead the consumers by choosing the prepackaged food which are not suitable for their diet.

According to the report of Malaysian Investment Development Authority (MIDA) 2012, Malaysia exported about $4.4 billion of processed food to more than 200 countries. The imported countries have their own authority to inspect the imported processed food are complied with the regulations, guidelines and standards before the products can be sold freely in the market. Hence this is important to ensure the nutrition labeling are précised and accurate to avert the loses.

On top of that, Malaysia also imported processed food which hardly planted in the country such as cereals, grains and dairy products. Country's authority has to ensure that the distributors of imported processed food have sent for lab testing to inspect the compliance of the nutrition labeling in accordance to Ministry of Health (MOH) guidelines. The authority body such as MOH has to make spontaneous operation in inspecting the compliance of the nutrition labeling of the processed or prepackaged food. Hence, a healthy nation can be build.

Therefore, three research questions arisen. First of these will be whether the nutrition values on prepackaged food in Malaysia can be trusted? Then what is the percentage of products are complied with the tolerance limits of Food Act 1983 and regulations and other guidelines? Lastly, are the current nutrition regulations are being enforced effectively as a result of the food manufacturers abiding the rules and regulations in producing nutrition label?

1.3 Research Objective

The objectives of the research are:

1. To investigate the accuracy of nutrition values on label for selected prepackaged food in Malaysia.
2. To study the percentage of compliance of selected prepackaged food products in Malaysia by comparing with three guidelines.
3. To study the current enforcement practice for nutrition labeling regulations in selected hypermarkets and government's authority.

1.4 Significance of the study

As discussed earlier, consumers nowadays are conscious about their own health, therefore nutrition labeling appeared on almost all prepackaged foods are situated in a commonplace. As stated in GAIN Report 2015, consumers are more educated and incline to consume convenient foods (prepackaged foods). The demand of convenient foods increased due to the reasons such as increasing of working ladies, consumers are coming from another states or not staying with family and easy assessable to prepackaged foods.

This is imperative that the nutritional values on the food labels are reliable since the users for this is escalating. Consumers are using this as a guideline for purchasing a healthier product (Campos et al., 2010). However, consumers' health are not being protected when they have purchased products with misleading nutrition label. Eventually, NCD patients are increasing to a critical amount. This will emerge a ripple effect as elaborated earlier; a sick employee will reduce the company's productivity and then the country's income decreased due to levy of tax is reduced when the company illustrated low profit (when the productivity is low). Citizens will obtain less subsidies from government when the country's income is reducing.

Free trade activity is more active compares to a decade ago. The exporting procedures is not as complicated as previous except the products required to prove that are safe from contaminants and the nutrition labels are complying with the guidelines and regulations of the specific countries. Therefore food manufacturers are advisable to provide trustworthy nutrition label before exporting to avoid rejection of importing and losses incurred. Meantime, consumers' health are guarantee.

1.5 Research Scopes

This research focuses on the compliance of the declared values on nutrition label as compared to the tolerance limit of Food Act 1983 and Regulations 1985. Meantime, the same values will be compared with tolerance limits which are implementing in other countries, and then the performance of compliance of prepackaged foods will be analyzed by the percentage of compliance for these three tolerance limits.

The tolerance limits applied in this research are:

a) One-way approach, which is implementing in Malaysia and stated in Food Act 1983 and Regulations 1985, Schedule 18 (Table 1.1).

b) Two-way approach, which is implementing in countries such as Japan, Korea, Thailand and etc (Table 1.1).

c) Local Authorities Coordinators of Regulatory Services (LACORS) where commonly used in Europe countries (Table 1.2).

Table 1.1: Tolerance limits of declared values of nutrition label as used for one and two-way approach

	One Way Approach	**Two Way Approaches**
Energy	≤120%	± 20%
Fat	≤120%	± 20%
Carbohydrate	≤120%	± 20%
Protein	≥80%	± 20%

Table 1.2: Tolerance limits of declared nutrients on nutrition label as set by LACORS

Type of Nutrients	Labeled Nutrients in Products	Tolerance Limit
Energy, Protein, Carbohydrate, Fat	More than 2% and less than 5%	± 30% of labeled value
	More than 5%	± 20% of labeled value
	Less than 2%	Use discretion based on individual circumstances

The prepackaged foods are stratified into eight categories which are prepared cereal food and bread, milk and dairy products, flour confection, canned meat, fish and vegetables, canned fruit and various fruit juices, snack and indulgence food, coffee, tea and other hot beverages and lastly is spread food. The samples for this research will be purchased according to the categories. The nutrients to be studied in this research are the mandatory nutrients which are Energy, Fat, Carbohydrate and Protein.

1.6 Method of Study

This research consists of an empirical study. About 100 prepackaged foods are purchased from few hypermarkets or food department stores in Klang Valley area. The choices of prepackaged foods are according to the food categories which have been stratified by researcher.

Analysis will be conducted on nutrients as Energy, Fat, Carbohydrate and Protein. Energy and Carbohydrate are based on the calculation by difference from Fat, Protein, Moisture and Ash. Fat, Protein, Moisture and Ash are conducted based on AOAC or other laboratory's in house method which are verified and have been assessed by Department of Standard Malaysia.

The relative percentage of difference (RPD) will be determined between analytical values and the declared values. Meantime, compliance results will be determined by referring to the tolerance limits of one-way approach, two-way approach and LACORS.

Then an interview session will be conducted with the person in charge of the department of Food and Safety Division from Ministry of Health Malaysia and also personnel from hypermarkets in Malaysia in order to understand the common practice for the surveillance of accuracy of nutrition labels.

1.7 Limitation of Study

The study only applied on the mandatory core nutrients which are Energy, Fat, Carbohydrate and Protein. Other nutrients such as minerals, vitamins or fatty acid profile are not included in the study.

Only 100 samples from eight food categories are chosen on the research. These are prepared cereal and breakfast, milk and dairy products, flour confection, canned meat, fish and vegetables, canned fruits and various fruit juices, snacks and indulgence food, coffee, tea and other hot beverages and lastly is jam, kaya and other spreads. The variety of samples may not ample to represent the trend of nutrition labeling in the market.

Homogeneity of samples for analysis not up to Codex Alimentarius, U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) or (Food and Drug Administration (FDA) requirement. According to these authorities, the proper sampling procedure would be 12 same batches of samples will be collected from market, and then all of these samples homogenized in the laboratory and only send for analysis. The results obtained only representative. Only three same batch of sample from the market will be selected for analysis, therefore homogeneity of samples may not be ascertained.

Lastly, measurement of uncertainty is not applied in the calculation due to no uncertainty values obtained from the declared nutrients from the prepackaged foods, conflicts will be appeared from comparison.

CHAPTER 2: LITERATURE REVIEW

2.1 Nutrition Label Regulations of Different Countries

In 1906, Food and Drugs Act was the first authority to introduce the food labelling practice to ensure the safety and integrity of food supply in the United States. Then, the Food and Drugs Act 1906 was replaced by The Federal Food, Drug and Cosmetic Act (FD&C) in 1938, where FD&C Act broadened the Food and Drug Administration's (FDA) authority with regard to the nutrient content of food and authorized FDA to establish mandatory food standards (Committee on Use of Dietary Reference Intakes in Nutrition Labelling, 2003).

After 1970, nutrition labelling policy moved forward to packaged food as there are concerns on enhancing healthier diet intake by Americans. By 1973, FDA had adopted several amendments to its regulations (Committee on Use of Dietary Reference Intakes in Nutrition Labelling, 2003). The main purpose of the amendments was to govern the nutrition labelling activity for prepackaged food. However, this amendment was not compulsory for food manufacturers to follow (Committee on Use of Dietary Reference Intakes in Nutrition Labelling, 2003, Wilkening, 1993). The mandatory practice of nutrition labelling for all prepackaged food was implemented in 1990. It was during the comment period for this proposed rules that the Nutrition Labelling and Education Act of 1990 (the NLEA) was passed by Congress and on November 8, 1990; it was signed into law by President Bush. This legislation affirmed FDA's authority to mandate nutrition labelling on most foods and went further to clarify the agency's role in regulating nutrient content and health claims on food labels (Committee on Use of Dietary Reference Intakes in Nutrition Labelling, 2003, Wilkening, 1993).

As for Malaysia, nutrition labelling is on voluntary basis. Local food manufacturers and distributors are not required to provide nutrition label for food products, except for special purpose foods (for example infant formula or fortified and enriched nutrients food) (FSQ MOH, 2010). After the amendments of Food Regulations in 2003, nutrition labelling is mandatory for food products as specified in regulations 67-75 (prepared cereal food and bread), 87-87, 89-99 and 113 (milk products), 135 (flour confection), 149, 151, 161 & 220 (canned meat, fish and vegetable), 233-242 (canned fruit and various fruit juices, 344-345 (salad dressing and mayonnaise) and 348-358 (soft drinks) (FSQ MOH, 2010). Consequently, Malaysia is one of the countries which made nutrition labelling mandatory because a wide range of foods is required to have nutrition information (Hawkes, 2004; FIA 2012). This is different from other countries in ASEAN where mandatory practice of nutrition labelling only applied for products which promoted health claims or nutrition comparative claims (Hawkes, 2004). Food manufacturers are responsible to provide values of energy, fat, carbohydrate and protein if their products required mandatory nutrition labels and this only apply in ASEAN countries (FSQ MOH 2010, AVA Singapore 2011, Bureau of Food and Drugs Manila, 1984, Government regulation of the Republic of Indonesia, 1999, FIA 2012).

There are about ten countries which mandated the nutrition information on all prepackaged foods. The countries include the United States which mandated the regulations in 1994, New Zealand and Australia which gazetted the regulations in December 2002 as well as Canada, Brazil, Paraguay, Uruguay, Argentina and Israel (Hawkes, 2004).

According to the HK Nutrition Label Reports, 2013, China and Hong Kong were categorized under the group of voluntary, except for certain foods with special dietary uses and no regulations respectively as stated in the report of Hawkes. Foods with special dietary uses are foods fortified with certain nutrients, diabetic food, low sodium food, gluten free food and infant formula as well as dairy products. To date, China and Hong Kong have made nutrition labelling mandatory for prepackaged foods.

China officially started implementing the nutrition labelling regulation in 2013 (Liu et al., 2015). Prior to this, the China government had notified the World Trade Organization (WTO) about the "National Food Safety Standard for Nutrition Labelling Prepackaged Foods", where it only prescribed the basic principles and requirements for the nutrition labelling and claims on prepackaged food directly offered to consumers but did not emphasise on mandatory practice of nutrition labelling (GAIN 2010).

The mandatory nutrient information on the prepackaged foods stated in the National Food Safety Standard for Nutrition Labelling Prepackage Foods in China is Energy, Protein, Fat, Carbohydrate and Sodium. This also applied to Hong Kong. They began to implement the nutrition labelling regulation on 1 July 2010 after 2 years of grace period. The mandatory nutrient information is Energy and Fat, Saturated Fat, Trans Fatty Acid, Carbohydrate, Sugar, Protein and Sodium (Health, Welfare and Food Bureau, 2013).

Due to the health status of individuals, public health goals, consumer behaviour, dietary patterns or living lifestyles of different population groups within countries; it has resulted in different regulations of nutrition labelling among countries (Wijngaart, 2012; Kasapila et al., 2013). This was correlated to the mandatory practice of nutrition label as discussed earlier and the tolerance limit between declared values and analytical values on nutrition labels are different from countries to countries as well.

As stated in the Guide to Nutrition Labelling and Claims 2010, food manufacturers are required to fulfil the tolerance limit for the nutritional values on the labelling. They need to ensure the actual nutritional values obtained from the analysis done are not above the limits. This is a way of the countries' government to control food manufacturers who provide deceptive or misleading nutritional values on prepackaged food and eventually, this can protect consumers from buying food which are not suitable for them.

The tolerance of acceptance range is not homogenized for some countries. This is due to some source of uncertainty factors (Figure 2.1). The first factors appeared from the method of analysis. Apparatus or equipment used for the analysis, purity of chemical used and human errors may attribute to the uncertainty (Fabiansson, 2006). Additionally, seasonal variability may cause the variation too according to the report of Food Safety of Ireland, 2010. For example, chili peppers may become more or less pungent if they are stressed. The stress mentioned is climate change such as high temperature or over watering (Gonzalez-Zamora et al., 2013). Additionally, the composition of reducing sugar, capsaicinoids and vitamin C in *Capsicum annuum L.* varied in correlation with climatic elements such as total accumulated air temperature, total amount of precipitation and sunshine duration (Cho, et al., 2004). These are the reviews which had observed that the composition of food will vary from time to time.

In addition, the deviation of nutrition value on the labelling from actual analysis results may occur during production or storage. However, nutrient content should not deviate substantially to the extent that consumers are misled (Food Safety of Ireland, 2010). Therefore, some countries capped the tolerance limit at ±20% which is very reasonable (Fabiansson, 2006). Therefore, food producers need not have to worry that their products breach the limit. This reasonable tolerance limit encourages more food producers to apply the nutritional label standards and guidelines.

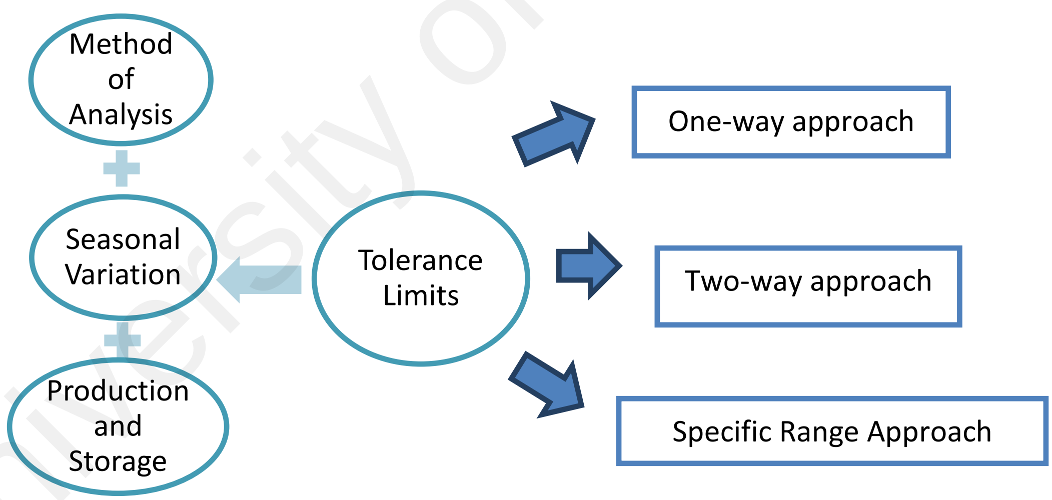

Figure 2.1: Uncertainty factors contribute to tolerance limits

Countries such as Thailand, Japan and Taiwan provide tolerance limit to a specific range of ±20% for macronutrients as suggested by Fabiansson. Whereas countries in some ASEAN region (such as Indonesia, Brunei, Philippines and Singapore) implemented the tolerance limit as guided by Codex, which are ≤120% for Energy, Fat and Carbohydrate (which are considered as bad impact nutrients). Protein which is considered as good impact nutrient must be ≥80%. This tolerance limit is being used in Malaysia as stated in Schedule 18C Fifth A Schedule, Food Act 1983 and Regulation 1985 (Table 2.2).

Table 2.1: Tolerance limits for nutrient declaration on nutrition labels of different countries

Tolerance Limits	One-way approach	Two-way approach	Specific Range Approach*
Criteria for compliance	Energy < 120% Fat <120% Carbohydrate <120% Protein >80%	±20% for Energy, Fat, Carbohydrate and Protein	±30% for declared values 2 – 5% ±20% for declared values > 5% Declared values <2% use discretion based on individual circumstances
Countries executing	Malaysia, United States, China, Hong Kong	Thailand, Japan, Taiwan, Korea, Australia	European countries

*Adopted from Local Authorities Coordinators of Regulatory Services (LACORS) in the United Kingdom

Table 2.2: Criteria for compliance of analytical level according to regulation 18C Fifth A Schedule

Nutrients	Criteria for Compliance
Energy	
Fat	<120% of the declared nutrient value on the label
Carbohydrate	
Protein	≥80% of the declared nutrient value on the label

Most countries are using the nutrition labelling regulations or guidelines as aforementioned, namely the label value should fall within a specific range of ±20% and the label value should be equal, less than or equal and more than a maximum or minimum value such as what is implemented by Malaysia. However, some countries such as Australia and some European countries do not use the two-way approach tolerance limits (or leeway ± 20%). In addition, the guidelines of tolerance limit of variation of nutrition information legislation are vague in Australia (Fabiasson, 2010). Fabiansson has commented that in his findings, the European Council Directive on nutrition labelling for food stuffs does not provide a clear tolerance limit even though a specific range approach of 1.5g if the value is less than 10 g/100g, 15% if the value is between 10-20 g/100g and 3g if the value is more than 20 g/100g for carbohydrates, protein and fat as has been deliberated and incorporated in some countries' legislation. This approach definitely will be confusing because at certain range the tolerance value suggested refers to mass of nutrient yet at the range of 10-20 g/100g of nutrient it will be in percentage. This has been improved by the Local Authorities Coordinators of Regulatory Services (LACORS) in the United Kingdom.

The new tolerance guidance is much more prescriptive and is designed based on statistical framework. In the guidelines, the tolerance level for labelled nutrient of food stuffs more than 2% and less than 5% are ±30% of the labelled value; ±20% if the labelled value is more than 5% and labelled value which is less than 2% has to use discretion based on specific individual circumstances (Table 2.1). This tolerance guidance is being used in most of the European countries (Food Safety Ireland, 2010). This statistical approach takes into account nutrient variability in food as well as method variability.

2.2 Implications of Nutrition Label

2.2.1 Improving Public Health Issue

Globally, obesity has become a pandemic with prevalence statistics escalating rapidly among many levels of society in both developed and developing countries (Prentice AM, 2006). In Malaysia, the number of obese citizens has increased to 250% from year 1996 to 2006 and to date, 17.7% or 3.3 million Malaysians aged above 18 years are obese, while 30% or 5.6 million are overweight (NHMS, 2015). Moreover, reports from the National Strategic Plan for Non-Communicable Disease (NSPNCD) showed dramatic increase of hypertension and diabetes at 43% and 88% respectively in the same period of year (NPNCD, 2010). This situation became worse when WHO reported that diabetes patients have reached 2.6 million in 2011 whereas the prediction of WHO on the number of diabetes patients in Malaysia are 2.48 million in 2030; unfortunately the number of diabetes patients in Malaysia has exceeded WHO prediction (Zhang, 2014). Four out of five of Malaysia citizens are not aware that they had high cholesterol and this involved 38.6% or an estimated 7.8 million of Malaysian (Bernama, 2016).

By seeing the substantial figures of the alarming rate of NCD, the Malaysia government had launched the Nutrition Policy of Malaysia in August 2002 and revised the National Plan of Action of Nutrition (NPANM II) for the period 2006-2015. The aim for NPANM II is to prevent and control diet related NCD. On the other hand, there are some strategies stated in the Tenth Malaysia Plan to solve the problem of NCD. The strategies include promoting healthy eating habit among consumers by choosing a healthy diet;

encouraging food producers to provide healthier food choices to consumers and planning a programme to educate consumers to choose the right food for consumption.

Other than the national strategies, international bodies like WHO is promoting strategy to reduce the risk factors for NCD. For instance, in May 2004, the 57th World Health Assembly (WHA) endorsed the World Health Organization (WHO) Global Strategy on Diet, Physical Activity and Health (DPaH). The strategy was developed through a wide-ranging series of consultation with all concerned stakeholders in response to a request from Member States at the World Health Assembly 2002. This strategy is gathering efforts from the stakeholders, public and private sectors to overcome NCD issues. For example, to recommend to the food industry to continue to develop and provide affordable, healthy and nutritious choices to consumer; to issue simple, clear and consistent food labels and evidence-based health claims that will help consumers to make informed and healthy choices with respect to the nutritional value of foods and et cetera (Tee, 2014).

2.2.2 Consumers' Perception and Awareness

Nutrition label acts as a communication tool (FSQ, MOH 2010). Consumers can obtain the nutrient information from this, no matter whether the nutrients are beneficial or detrimental to health because nutrition label should not deliberately imply that the food only carry good nutrients (Wijngaart, 2002). This tool can educate consumers in considering the purchasing intention through the nutrient values on the label while they do not have the opportunity to taste or smell the products prior to purchase (Kasapila, 2011).

Nutrition labelling gives direct effect to nutrient intake. For instance, the intake of fat declined after the implementation of advertising and labelling regulation in the United States (Ippolito, 1999). Moreover, after the implementation of mandatory practice for nutrition label by NLEA in 1990 in the United States, there were some researches conducted to prove that this regulation brought benefits to the public. For instance, in the research conducted by Kristal, R., et al., in 1998, he found that the users who used nutrition label on fat content increased significantly by 8.5% in women and 11.3% in men. In addition, risk of health diseases and some types of cancer was also reduced in regards with the implementation of mandatory practice of nutrition label on most of the prepackaged foods (Kozup et al., 2003). Moreover, consumers (especially less knowledgeable) began to change their attention towards those negative nutrient attributes more than positive attributes as the impact of NLEA (Balasubramanian, K., et al., 2002). On top of that, NLEA is also applied to restaurant menu items. When nutrition information was presented, consumers have a more favourable attitude towards the products and increased the purchase intentions, thus also increased awareness of the risks of heart diseases (Kozup, C., et al., 2003).

The consumers' perception towards nutrition label has little transition after 2010. Consumers are inclined to use nutrition labels for the goal of weight control and to make healthier food choices (Prieto-Castillo et al., 2015, Besler, H.T., et al., 2012, Colby et al., 2012, Campos et al., 2010). Among the consumers who use nutrition labels, consumers with higher socioeconomic status, receive higher education, women and young individuals were found to use nutrition labels the most (Campos et al., 2010). Majority of the individuals with higher socioeconomic status receive greater education, thus they are able to comprehend the basic information on nutrition label and get benefit from the nutrition labels (Sinclair et al., 2013). Additionally, this group of individuals are able to make more accurate decision before purchasing (Miller et al., 2015) as they have better nutrition knowledge as well as able to comprehend and focus their attention on nutrition labels easily. The prevalence of Internet and web-based interactions also increased the usage of nutrition labels especially in middle-aged individuals or youngsters (Campos et al., 2010) as consumers are able to assess the appropriate diet and nutrition information which in turn facilitate in reducing the obesity epidemic (Jung et al., 2016). Lastly, women were reported to be more often to use nutrition labels than men in majority of the studies (Campos et al., 2010).

Subsequently, consumers commonly use nutrition label as a decision making tool before purchasing. According to the systematic review on the nutrition labels on prepackaged foods conducted by Campos et al., 2010, 82%, 52%, 47% and 75% of individuals in New Zealand, Canada, European region and the U.S.A respectively used nutrition labels for making decision of purchasing. In addition, 38.8% of consumers require nutrition labels to assist them to make purchasing decision (Prieto-Castillo et al., 2015). In Turkey, 72.4% of citizens used nutrition labels (Besler et al., 2012). Additionally, most individuals at the age <60 in Korea used nutrition labels to make purchasing decision as well (Kim et al., 2015).

From the above reviews, this can be foreseen that nutrition labels are implausibly important. Humans in this modern era are eligible to receive higher education so they are able to obtain nutrition knowledge from books and borderless Internet. Consequently, they manage to make healthier food choices from the nutrition labels. Therefore, it is very important to get credible nutrition information on prepackaged food for the sake of building a healthier population.

2.2.3 Challenges for Food Manufacturers

As discussed earlier in chapter 1, free trade activity is advancing currently. Food manufacturers should always abide to the standard and guidelines which are related to the safety issues and definitely to comply with the regulations of nutrition labelling in order to success in the trade. Food manufacturers usually refer to Codex Alimentarius Commission on the nutrition labelling guidelines. In addition, food manufacturers are able to follow standards for free trade activity as applied by Codex in the framework of Technical Barriers to Trade (Wijngaart, 2002). However, this may be a challenge for small and medium size manufacturers in food industries as most of them are still doing business in traditional way (AHK Report, 2012); thus they may not able to interpret the guidelines as stated either in the Food Act or Codex.

Nutrition label requirements are different among countries. As discussed earlier, mandatory practice of nutrition information, declaration of nutrients and tolerance limits are different across the regions. These kinds of policies create conflicts among food manufacturers (Orquin et al., 2015). For instance, nutrient reference value (NRV) for sodium is different between FDA format and China format. The reference values of sodium are 2400mg (Food Labelling Guide 14, Appendix F, US FDA) and 2000mg (GB28050-2011) per 100g serving for FDA and China format respectively. Conversely, the reference values of fat are 65g and 60g for FDA and China NRV format respectively. NRV per 100g for iron (FDA = 18mg; China = 15mg), calcium (FDA = 100mg; China = 800mg), vitamin C (FDA = 60mg; China = 100mg) and other nutrients are different between FDA and China as well. On top of that, food manufacturers are also required to be concerned of the languages, claims criteria and serving size on nutrition labels. These create difficulties for food manufacturers which are involved in international trade activities in developing nutrition information (Wijngaart, 2002).

Nevertheless, there is no clear guideline stated neither in Codex or Food Act 1983 to instruct food manufacturers about the renewal frequency of nutrition label. Whether the nutrition label can be applied on the prepackaged food indefinitely since the formula remains unchanged or must it be reanalysed for every batch of production? If food manufacturers choose to retain the nutrition label, how confident that they ensure the nutrient declared values remained unchanged or still acceptable within the tolerance limits?

Food manufacturers have different way to produce the nutrient values on the nutrition information. The most common and reliable way is by sending their products to an accredited analytical laboratory. From a study by Judprasong et al., 2012, laboratories in Thailand managed to achieve satisfactory (z scores ≤ 2) analytical results for nutrition analysis. Therefore, nutrient values produced from analytical laboratories are reliable.

However, food manufacturers are forced to increase the cost of production by getting analytical service from analytical laboratories.

In order to reduce the cost of production, food manufacturers can apply alternative methods to produce nutrition information. One of this is by extracting data from food composition databases. However, there are some challenges arisen by using this method. The data from the food composition databases may not be updated as current as possible (Cunningham, 2011). Moreover, the data provided from the databases may illustrate significance variation. For example, the fat content of pork belly is 45% as stated in USDA food composition database but the fat content was about 30% in pork belly as tested in South Korea (Choe et al., 2015). Furthermore, the chemical composition such as fat content or moisture content would vary between gender, genetic background and diet (Veranic et al., 2015; Choe et al., 2015). Nutrients such as vitamins are a big challenge in using labelling database (Cunningham et al., 2011). For instance, vitamins such as vitamin C is easily destroyed from processing, treatment or transportation since vitamin C is light and heat sensitive, therefore the possibility of nutrient declared deviated from actual is significantly high (Smith et al., 2011).

2.3 Research on Nutrition Label

2.3.1 Front of Pack Labelling

Nutrition information on food label plays a vital role in promoting healthy nutrient intake (Grunert et al., 2010). The use of nutrition information has been directly influencing healthy dietary choices with respect to calories, fat and nutrients (Sinclair et al., 2013; Wansink et al., 2006; Prieto-Castillo et al., 2015).

There are many researches conducted in order to improve the usage of nutrition information by consumers. Instead of nutrition information printed on the back of the package (BOP), front of pack (FOP) labelling scheme is widely applied in the European Union and the usage penetration of FOP on the prepackaged food in the United Kingdom and Ireland is also high (Bonsmann et al., 2010). FOP information is easier to understand compared to back of pack (BOP) (Grunert et al., 2010). Grunert commented that this FOP scheme highlighted more comprehensive nutrition information because consumers manage to interpret directly the percentage of daily allowance (GDA) whereas BOP may not provide the actual GDA due to the unreliable serving size. Additionally, consumers are able to discern the amount of four key nutrients fat, saturated fat, sugar and salt from the traffic light label (the labels are colour coded as red, yellow or green to reflect the content of the nutrients).

From a review of Hawley, L., 2013, this FOP traffic light scheme has consistently assists consumers to identify healthier products. This scheme was agreed by Temper, J., and Fraser (2014) in their critical assessment of food label. They have suggested that the governments of the United States and Canada to enforce this FOP labelling scheme even though it may encounter strong opposition from the food industries. However, Crosetto et al., found that GDA format was more effective to be comprehended by consumers compared to traffic light label format, whereas Herpen et al., (2011) has concluded that both GDA and traffic light format could increase healthier products selection.

Healthier choice logo is another type of FOP design. Vyth has proven in his study that this FOP labelling could contribute positively towards nutrition label; thus manage to reduce the risk of cardiovascular diseases.

The implications of FOP formats are very subjective. This may be similar to the circumstances in variance of nutrition labelling regulations among the countries where different countries have their own culture and living lifestyles which may influence their selection on the FOP format.

2.3.2 Accuracy of Nutrition Labelling

As discussed in the earlier section, there are many researches related to FOP labelling which have been conducted to improve the consumers' healthier food choice. However, there is no proof to show or any query done on the accuracy of the declared values either on FOP or BOP.

The research affiliated to the accuracy of nutrition information is very little. There was one conducted by Fabiansson in 2006 to investigate the precision of nutrition information declaration on food labels in Australia. Fabiansson analysed 350 samples from

70 different products (five replicate samples for each product) for nutritional compounds declared on the labels and he found that 10% of the declared energy from these products did not comply with the tolerance limit of leeway ±20%. Additionally, 41%, 23% and 20% of declared values for fat, carbohydrate and protein did not comply with the tolerance limit (Table 2.3).

Another similar research has been conducted by Food and Safety Authority of Ireland in 2010. In the report, the percentages of products of compliances were referred to the guidelines of LACORS. There were 14.6% of products which did not comply with the analytical value of energy, 4.5% of products failed to comply with analytical value of carbohydrate and the declared values of protein also did not comply with the tolerance limit which was 4.5% (Table 2.3). It must be noted that energy was not covered in this research. In this report, a total 89 samples were selected for the study, each product having 3 samples and a total 267 samples were analysed. Measurements of uncertainty for the analytical results were not involved in the calculation for both studies.

Table 2.3: Percentage of non-compliance products for previous studies using guideline of Leeway ± 20% and LACORS

	Percentage of Non-compliance (%)	
Nutrients	Leeway ± 20%[a]	LACORS, 2010[b]
Energy	10	NA[c]
Fat	41	14.6
Carbohydrate	23	4.5
Protein	20	4.5

[a] Previous study conducted by Fabiasson, 2006
[b] Previous study conducted by Food and Safety Authority of Ireland.
[c] Not Available

Urban et al., has conducted a study on the accuracy of stated energy contents for commercially prepared foods in 2010. Urban et al., found that the energy content on the nutrition labels (for products sold in supermarket) averaged 8% more than originally stated for all products. She concluded that the measured energy content exceeded vendor-stated amounts could have happened due to laboratory measurement error. However, this study might not be significant because there are only ten data collected from the supermarket.

The researches related to accuracy are only found in the United States, Australia and Ireland (nutrition label mandatory countries) but there is no proof to show that similar researches have been conducted in ASEAN countries (voluntary nutrition label countries).

Chapter 3: Method of Research

3.1 Conducting Literature Review

Journals and reference books which are related to the research were searched on the Internet and the databases available in the library of University of Malaya. The topics searched are mainly on accuracy or compliance of nutrition label, public health, non-communicable diseases, economic, consumers' awareness and education on nutrition labelling and analytical procedure for nutrition analysis.

In addition, current news or reports related to non-communicable diseases and free trade activity as well as statistical data related to import and export products from Malaysia were searched from the Internet or newspapers.

3.2 Samples Collection

Random-sampling techniques to collect samples to be analysed are applied in this research. Samples are purchased according to the food categories from different stores in Klang Valley without looking at the price and brand. This method is inevitable due to the economical and practical consequences associated with the randomization process (Jeon, 1995). While samples are chosen, the researcher must be as objective as possible to avoid any obvious sampling biases (Joslyn, A., 1970).

According to FDA regulations Act 170.3, foods are grouped into 43 categories before being launched into the market. Furthermore, manufacturers need to specify their products into the related categories for the purpose of establishing tolerance and limitations for the use of direct human food ingredients. This kind of food categories can be found in other countries' food regulations, such as the Food Act and Regulation of Malaysia, 1983 and Singapore Agri-Food and Veterinary Authorisation. However, this is not applicable to supermarkets, department stores and groceries where they categorised the items into general groups which are common and easier to be understood by consumers. They normally grouped the prepackaged food products into categories like noodles and pastas, breakfast and cereals, beverages, frozen foods, confectionery, sauces and spices, canned foods, dairy products, snacks, bakery products and et cetera.

The researcher has adopted these food categories from both government regulations and supermarket grouping procedures for this study. The researcher has categorised the prepackaged food into eight categories and a clear definition is given to each category to ease the sampling procedure (Table 3.1). At least ten samples were randomly picked from each category based on the definition. A total of three same batches of each product were purchased for precision analysis.

Table 3.1: Food category definition and example of products

Food category	Definition	Type of Food
Prepared Cereal Food and Bread	Foods produced from processed grains that are eaten as the first meal for the day.	Prepared cereal food (including breakfast cereal), bread (white bread, milk bread, fruit bread, et cetera), Bread with cream.
Milk and Dairy Products	Food or beverage where the major ingredient is milk, or food that contains milk or derived from milk.	Full cream milk, skimmed milk, flavoured milk, evaporated milk, creamer, fermented milk, cultured milk, full cream milk powder.
Flour Confection	Food that is rich in sugar and carbohydrate and normally required baking prior to be sold in the market.	Any cakes or biscuits
Canned Meat, Fish and Vegetables	Meat, fish and vegetables that are kept in aluminium or suitable container after going through a pasteurization process. Pre-heating may be required for some foods.	Canned meat, canned meat with other food, canned fish, canned vegetable
Canned fruit and various fruit juices	Fruits that are kept in aluminium or suitable container after going through a pasteurization process.	Canned fruit, canned fruit cocktail, fruit juice (apple juice, grapefruit juice, lemon juice, lime juice, orange juice, passion fruit juice pineapple juice)
Snacks and Indulgence Food	Food that is normally consumed between regular meals and the portion is smaller than regular meal.	Potato chips, ice-creams, nuts, candies, flavoured crackers.
Coffee, Tea and other hot beverages	Food that requires hot water dilution prior to consumption. Must be in liquid form.	Plain coffee, coffee with milk, coffee with creamer and sugar, chocolate drink, soy milk powder, tea, tea with milk, tea with creamer.
Spread	Food that has been processed in semi solid forms which are easier to be spread with a knife on bread or biscuits.	Fruits jam, pandan kaya, coconut kaya, peanut butter, chocolate spread, hazelnut chocolate spread.

Source: Part E of Annex II to Regulation (EC) No. 1333/2008 (2007), Attachment 23, List of Product Category and Products, US FDA (2016), Guide to Nutrition Labeling and Claims, FSQ MOH (2010) and Oxford Dictionary of Food and Nutrition, Bender (1996).

There are five categories of prepackaged food which are required to have mandatory nutrition labelling as stated in the Food Act 1983 & Regulations 1985. The categories are prepared cereal food and bread; milk and dairy products; flour confection; canned meat, fish and vegetable and canned fruit and various fruit juices. These foods are important and consumed frequently in significant amount (FSQ MOH, 2010; Grunert, 2010). The other four categories which are not required to have mandatory nutrition labelling but are being collected by the researcher in this research due to the same reason aforementioned. Snacks and indulgence food get high demand from adolescents which can trigger obesity in adolescents group (Elliot, 2007; Grunert, 2010). Coffee, tea and hot beverages are another prepackaged food which receive great demand from consumers due to convenience of preparation and cultural transition, whereby Nestlé Malaysia led coffee in 2014 with 41% value shares, reaching sales of MYR613 million. This has proven that this category of food is getting massive demand by the consumers (Euromonitor International, 2015). The last category would be spread food, which is usually combined with bread (a type of food that requires mandatory nutrition labelling), thus it is significant in consumption.

All prepackaged foods chosen were non-perishable and ready to eat. Non-perishable and ready-to-eat foods do not need to go through heating or other cooking process which would change the composition of the food. Therefore, this will provide more accurate empirical results towards the research.

3.3 Method of Analysis

A total three samples from the same batches of prepackaged foods purchased are grounded into powdery or fine particles form to make the samples homogenized. On the contrary, liquid samples without particles are directly taken for analysis. Four analysis parameters chosen for this research are Energy, Total Fat or Fat, Carbohydrate and Protein. Results of Energy are obtained from the calculation of Carbohydrate, Fat and Protein. As for Carbohydrate, the results are obtained from differential calculation of Fat, Protein, Moisture and Ash. Therefore, Total Fat or Fat, Protein, Moisture and Ash analyses are also involved in this research. The analysis methods are referred from Official Method of Analysis of AOAC International, 16th Edition and Pearson's Chemical Analysis for Food, 7th Edition (Table 3.2 and Figure 3.1).

Table 3.2: Standard test methods for specific test parameters

Test Parameters	Standard Test Methods	Procedures
Energy	Method of Analysis for Nutrition Labelling (AOAC 1993)	Refer appendix A1
Carbohydrate	Method of Analysis for Nutrition Labelling (AOAC 1993)	Refer appendix A2
Fat		
• Milk and dairy products, beverages and juices	AOAC 989.05	Refer appendix A3.1
• Canned meat, nuts, cereals, grains and cocoa products	AOAC 963.15	Refer appendix A3.3
• Fruits, vegetables, noodles and pasta	Pearson's Chemical Analysis of Foods, 7th Edition, 1976	Refer appendix A3.2
Protein	AOAC 991.20	Refer appendix A4
Moisture	AOAC 931.04	Refer appendix A5
Ash	Pearson's Chemical Analysis of Foods, 7th Edition, 1976.	Refer appendix A6

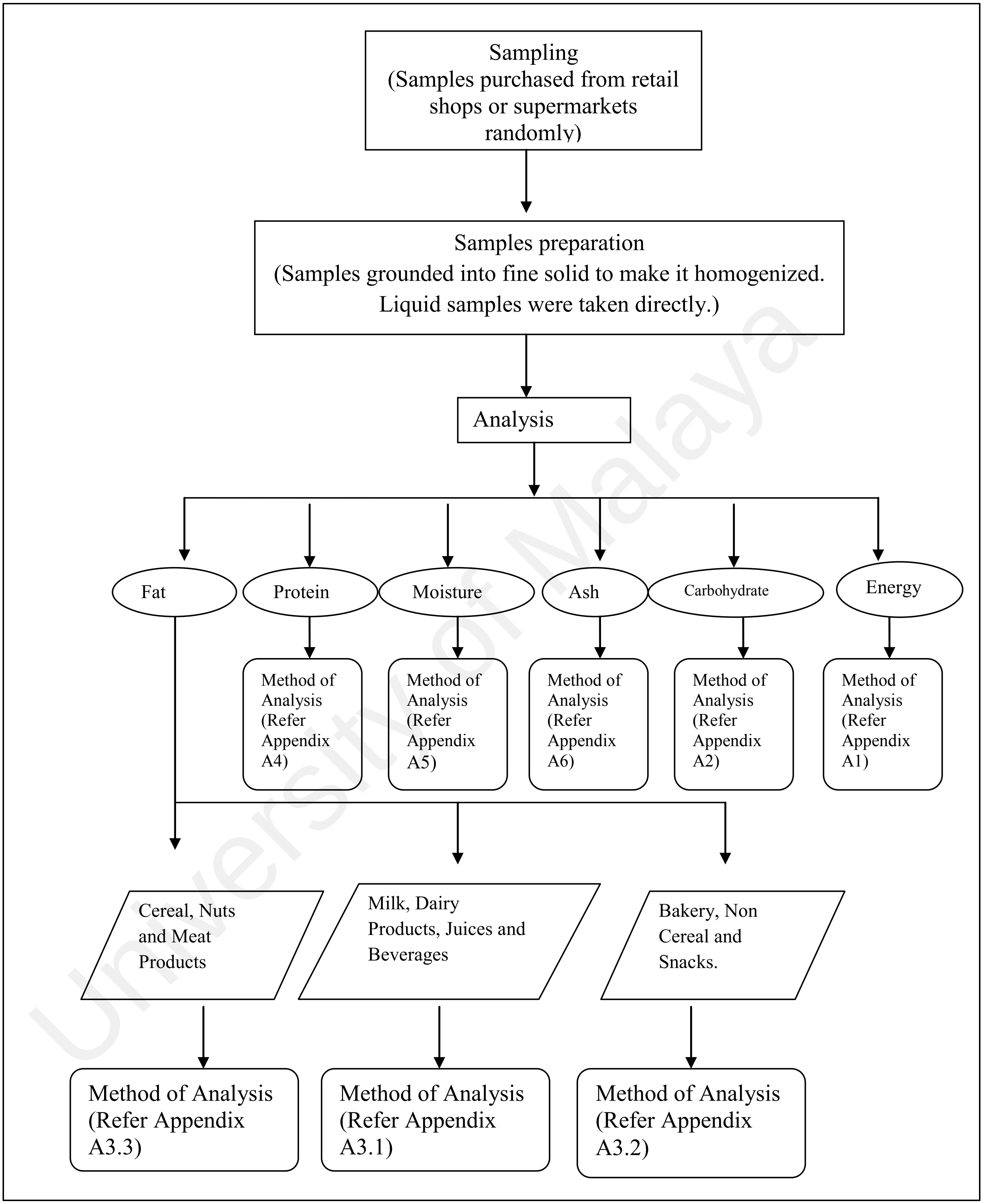

Figure 3.1: Flow chart of analysis

3.3 Measurement of Uncertainty

Measurement of uncertainty was not involved in this study.

3.4 Quality Control

Triplicate analysis was conducted on the same batch of samples. Moreover, results would be rejected and required to be reanalysed if the relative standard deviation (RSD) exceeded the requirement as suggested by Horwitz (Refer Table 3.3). Re-analysation can be halted when the results meet the Horwitz rules (Rivera et al., 2010). All equipment used is required to be verified beforehand. Analytical balance used must be calibrated by accredited calibration laboratory and verified with calibrated 1g standard weight. Calibrated analytical balance is important for gravimetric analysis such as moisture and ash, which directly reflect the accuracy of carbohydrate and energy. Heating equipment such as air oven and furnace requires an accredited lab for calibration before the analysis begun as well. Additionally, the researcher is required to verify this equipment using calibrated thermocouple prior to analysis. Analysis should be halted when the display value of thermocouple showed more than 10% deviation from the method. In addition, all chemicals must be purchased from ISO certified companies and the chemicals should have certificate of analysis.

Table 3.3: Values of Horwitz equation at different concentration

Analyte Concentration	Relative Standard Deviation (RSD)
10%	2.8
1%	4.0
0.1%	5.7
0.01%	8.0

Source: Horwitz equation as quality benchmark in ISO/IEC 17025 testing laboratories. (Rivera et al., 2011)

3.6 **Interview Session**

Phone interview session is conducted with the officer from the Food Safety and Quality Division from Ministry of Health Malaysia in order to get a clear picture about the common practice of surveillance of nutrition labelling accuracy from industries and any punishment to be imposed to food manufacturers who fail to comply with the Food Act 1983 and Regulations 1985.

Additionally, interview session with the person in charge of quality department from the main supermarkets in Malaysia is also held in order to know whether there are any policies related to the surveillance of accuracy of nutrition labelling from their suppliers as well as any common practice being followed.

Questions to be asked to the interviewees are:

1) Is there any non-schedule cross check practice applied on the accuracy of nutrition label?
2) How to ensure the accuracy of nutrition labels on the prepackaged food?
3) What are the actions taken for non-compliance?

CHAPTER 4:RESULTS

4.1 Overview

The objective of this study is to investigate the accuracy of the nutritional values declared on the prepackaged food. From this study, the percentage of compliance of prepackaged food in Malaysia was determined by comparing it with the Food Act 1983 which is considered as one-way approach tolerance limits. Meanwhile, similar products were compared with another two tolerance limits guidelines which are leeway ± 20% (two-way approach) and LACORS as briefly discussed in Chapter 2. The purpose of comparing the nutritional declaration with three different tolerance limits was to determine the capability of Malaysia's products whether it managed to comply with tolerance limits for free trade activity even though with non-homogenization of these limits. Moreover, the nutrients and food category which were unable to produce accurate nutrition information could also be determined from this study.

4.2 Accuracy of Declared Nutrition Information

By referring to Figure 4.1, fat was the nutrient that was illustrated as the best nutrient which showed 0% Relative Percentage Difference (RPD) of nutrient declared compared with analytical value (analytical values = labelled values), 11% of the products determined from the analysis has the same value as the declaration on the packaging for fat content. The major contribution of this 11% was from the products of canned fruits and fruit juices (Table 4.1) due to the fact that canned fruits and fruit juices were fat free, thus the analytical values were 0% definitely. In addition, 2% and 1% of the products illustrated the same values of nutritional declaration and analysis for energy and carbohydrate respectively. Munchy Oat Krunch and IKO Digestive Biscuits were products that illustrated 0% RPD, whereas Carbohydrate for Promex Chocomalt Malted Chocolate Drink was the only product that showed 0% RPD. Additionally, 4% of the products showed same values for protein, which were Nestle Mat Kool Icy Grape, Lemon and Lime Flavoured Ice Confection, Drinme Orange Fruit Drink with Jelly, Tamek 100% Apple Juice 100% Apfelsaft and the last one was Sunkist Orange Fruit Drink (Table 4.2). The major ingredients of these products were water, flavouring and colouring which do not contribute any protein content; thus the RPD could be 0%.

Table 4.1: Number of complied and non-complied products according to different guidelines

Food Category	**Food Act 1983**		**Leeway ± 20%**		**LACORS**	
	Complied	Non Complied	Complied	Non Complied	Complied	Non Complied
Prepared Cereal and Breakfast	10	3	5	8	6	7
Milk & Dairy Products	9	3	4	8	8	4
Flour Confection	7	5	4	8	4	8
Canned Meat, Fish and Vegetables	4	6	0	10	1	9
Canned Fruits and Various Fruit Juices	8	2	3	7	6	4
Snacks and Indulgence Food	10	10	5	15	6	14
Coffee, Tea and other Hot Beverages	12	1	4	9	7	6
Jam, Kaya and other Spreads	6	4	2	8	6	4
Total	66	34	27	73	44	56

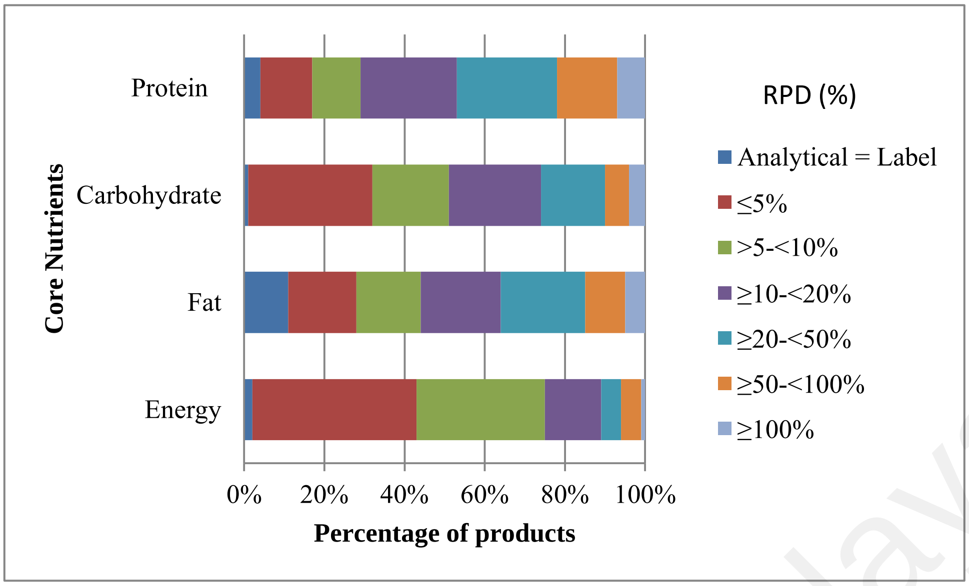

Figure 4.1: Percentage of difference between nutrition values and analytical values for each core nutrient

Referring to Figure 4.1, there was 7% of declared values on prepackaged food that were totally different from the analytical values for protein content (RPD ≥100%). This is followed by fat (5%), carbohydrate (4%) and energy (1%). There were four canned fruits and fruit juices products which showed more than 100% of difference, which were Nutrico Lychee in Heavy Syrup, S&W Mandarin Oranges Selected Sections in Light Syrup, Ayam Brand Snacky Nanas and Marigold Peel-Fresh Mixed Blackcurrant Cranberry Juice Drink (Table 4.2). The protein content on the label for these products was 0% whereas there were positive readings from the analysis. Three samples of fat content on the labels were less than 0.1% and the analytical results were 0 to 0.2% which would produce RPD 200%. These products were Yakult Ace Light Cultured Milk Drink (label reading was 0%, analytical reading was 0.2% and RPD was 200%), Ayam Brand Fruit Cocktail Firm & Crunchy (label reading was 0.1%, analytical reading was 0% and RPD was 200%), Heinz Strawberry Jam (label reading was 0.1%, analytical reading was 0% and RPD was 200%) as shown in Table 4.2.

Table 4.2: Comparison of declared nutrients on nutrition information and averaged analytical results

No.	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
1	Promex Chocomalt Malted Chocolate Drink	369	431.9	15.7	13.5	11.3	17.7	74	74	0	7	8.55	19.9
2	Nestle Mat Kool Icy Grape, Lemon and Lime Flavoured Ice Confection	65	77	17.4	0	0	0	16.2	19.34	17.7	0	0	0
3	Drinme Orange Fruit Drink with Jelly	90	45.56	65.6	0	0	0	21	11.39	59.3	0	0	0
4	Tamek 100% Apple Juice 100% Apfelsaft	44	41.2	6.57	0	0	0	11	10.3	6.57	0	0	0
5	Sunkist Orange Fruit Drink	32	34	6.65	0	0	0	7.9	8.55	7.90	0	0	0
6	Nutrico Lychee in Heavy Syrup	130	63.68	68.5	0	0	0	33	14.88	75.7	0	1.04	200
7	S&W Mandarin Oranges Selected Sections in Light Syrup	48	80.36	50.4	0	0	0	15.1	19.07	23.2	0	1.02	200
8	Ayam Brand Snacky Nanas	75	74.8	0.267	0	0	0	18	18.09	0.499	0.2	0.61	101
9	Marigold Peel-Fresh Mixed Blackcurrant Cranberry Juice Drink	51	41.24	21.2	0	0	0	12.7	9.77	26.1	0	0.54	200
10	Yakult Ace Light Cultured Milk Drink	57	58.96	3.38	0	0.2	200	13.3	12.7	4.62	1.1	1.59	36.4

Table 4.2: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
11	Ayam Brand Fruit Cocktail Firm & Crunchy	81	53.84	40.3	0.1	0	200	18.7	12.49	39.8	0.4	0.97	83.2
12	Heinz Strawberry Jam	275	285.08	3.60	0.1	0	200	66.5	70.61	5.99	0.25	0.66	90.1
13	IKO Digestive Biscuits	491	491	0	20.4	24.3	17.4	62.2	53.1	15.8	8.3	10.8	26.2

Overall, energy was the most accurate nutrient examined with 79% of the products showed less than 20% of percentage difference. Carbohydrate was another nutrient that illustrated satisfactory accuracy after energy, with 74% of the products showed less than 20% of percentage difference. Protein was the nutrient that yielded the poorest accuracy among all examined parameters; there were about 47% of the products which declared protein on the packaging with more than 20% difference compared with the analytical values. This is followed by fat which was 36% of the products showed more than 20% difference (Figure 4.1).

The declared values of energy content on prepackaged food were 49% higher than the analytical values; conversely, 49% of declared values were lower than the analytical values and 2% of the products showed same for both declared and analytical values as shown in Figure 4.2.

13% of the prepackaged food showed no difference for both declared and analytical values for fat. 54% of the prepackaged food showed lower declared values compared to analytical values and 33% of declared values were higher than analytical values of fat.

About 60% of the prepackaged food showed higher carbohydrate content compared to the analytical values and 38% of declared values found were lower than analytical values. Only 2% of the products showed similar values for both declared and analytical values for carbohydrate content.

Lastly, 66% of the prepackaged foods declared higher protein content on the label and 19% lower in declared values compared to analytical values. However, protein was the nutrient that showed highest similarity of declared and analytical values among the studied nutrients. 15% of the products had same values for both analytical and declared values.

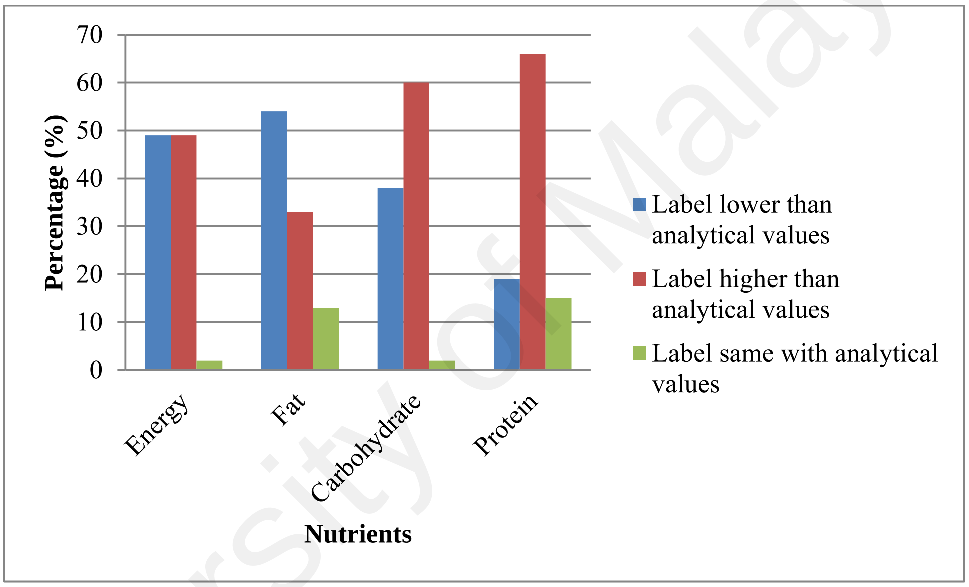

Figure 4.2: Percentage of products under or over declaring in comparison to analysis

4.3 Asymmetric of Tolerance Limits

The four major core nutrients analysed for each product were compared with the nutrition labels on the products. Either one or more analytical results which failed to comply with the tolerance limit were categorized in the group of non-compliance.

Overall, most of the products complied with the acceptance tolerance limit of Food Act (66%). Less than 50% of the products were able to meet the tolerance limit of leeway ± 20% and LACORS; there were 73% and 56% of the products that did not comply respectively as illustrated in Figure 4.3.

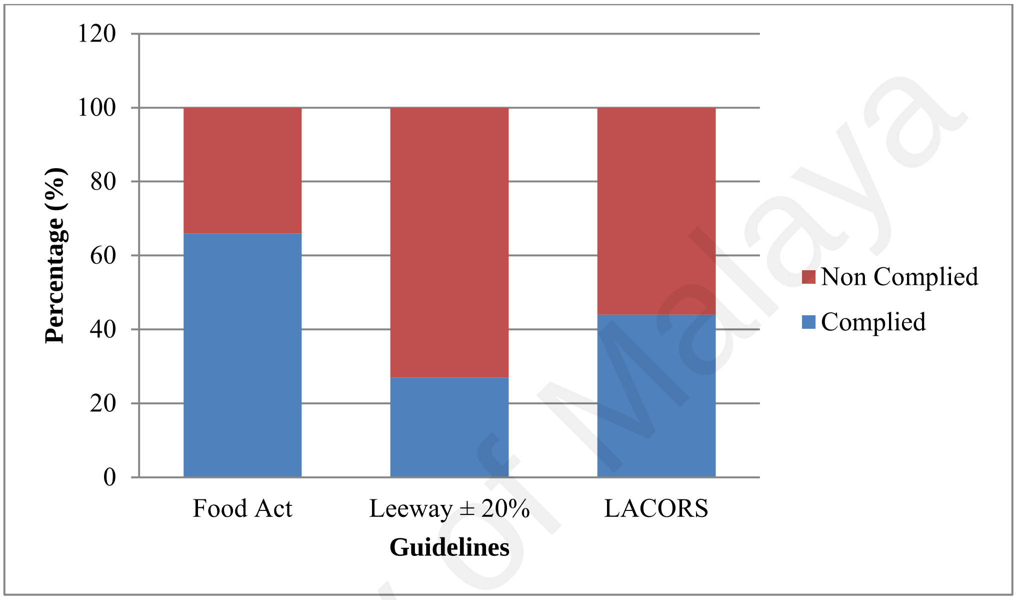

Figure 4.3: Percentage of all products that comply with specific guidelines

By referring to Food Act 1983, a total of 34 products did not comply with the regulations of the tolerance range. There were 60% of the products in the category of canned meat, fish and vegetables which did not comply with Food Act regulations. Percentages of products which complied and did not comply with the regulations were the same for snacks and indulgence food. Coffee, tea and other hot beverages showed the best compliance; only 8% of the products did not meet the acceptance tolerance range. The rest of the food categories showed percentage of non-compliance at 23%, 25%, 42%, 20%, 40%

for prepared cereal food and bread, milk products, flour confection, canned fruits and various fruit juices and jam, kaya and other spreads respectively (Figure 4.4).

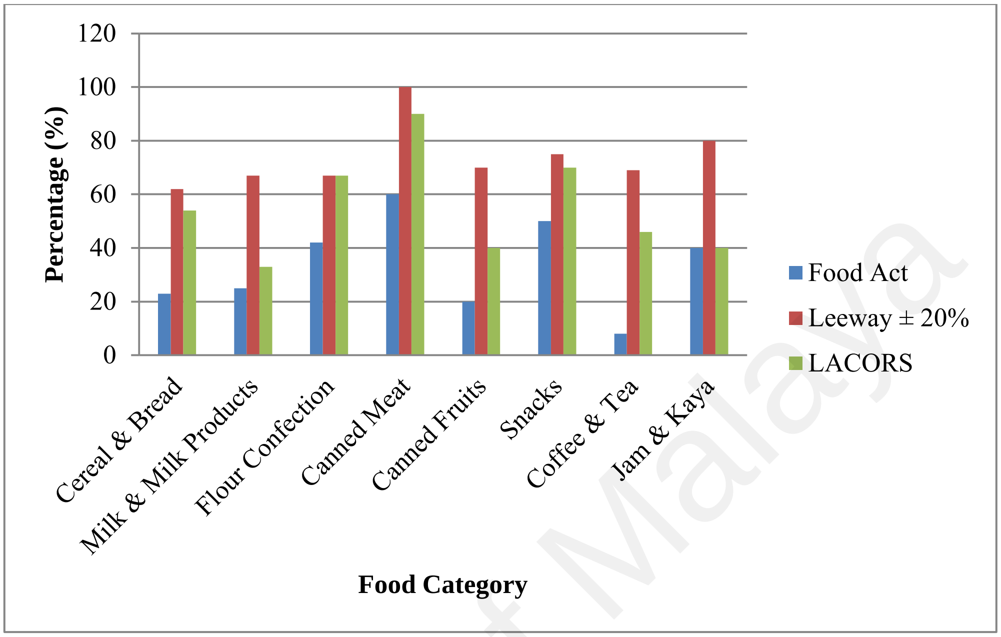

Figure 4.4: Percentage of products (in category) which do not comply with the specific guidelines

All categories showed higher non-compliant products in tolerance limit of leeway ±20%. Canned meat, fish and vegetables did not comply 100% (Figure 4.4) and only 20% of the products in jam, kaya and other spreads category complied with leeway ±20%. About 67% of the products in the categories of dairy products and flour confection did not comply with this tolerance limit. When the LACORS limit was used to measure the compliance of products, the percentage of compliance is better than solely referring to leeway ±20%. A total of four categories of products which showed more than 50% compliance; there were dairy products (67%), canned fruits and various fruit juices (60%), coffee, tea and other hot beverages (54%) and jam, kaya and other spreads (60%) as illustrated in Figure 4.4.

Canned meat, fish and vegetables were food category which showed the highest non-compliance among all other categories, 90% of the products in this category did not comply with the tolerance limit in LACORS. Generally; canned meat, fish and vegetables demonstrated poor product compliance as shown in Figure 4.4. Samples preparation for this category probably is not in uniformed condition as food manufacturers could not drain off the brine, oil or sauces before the analysis. This would definitely cause the nutrient composition to change. Coffee, tea and other hot beverages were able to demonstrate better product compliance because these products are normally in premix form and the samples are already homogenized. Therefore, there were no conflicts in sample preparation.

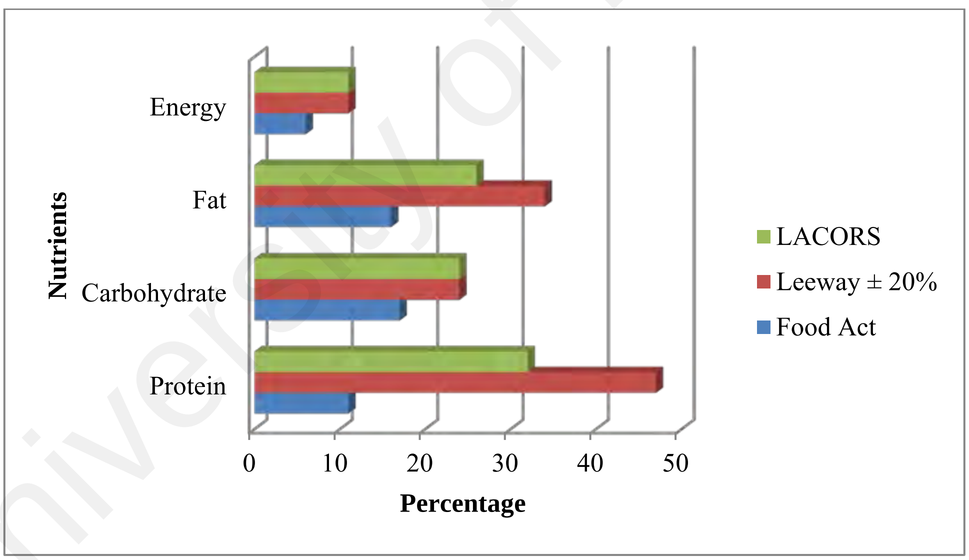

Figure 4.5: Percentage of core nutrients which do not comply with the specific guidelines

Based on Figure 4.5, protein was the worst nutrient to comply with the tolerance limits according to both leeway ± 20% and LACORS; with the percentage of non-compliance of protein for these tolerance limits were 47% and 32% respectively. On the other hand, for the tolerance limit of Food Act, products which failed to comply were 11%. This was better than carbohydrate (17%) and fat (16%). For the total 100 data of energy, percentage of non-compliance when referring to Food Act, leeway ± 20% and LACORS were 6%, 11% and 11% respectively. Nutrition labels of carbohydrate which failed to comply with the tolerance limits of leeway ± 20% and LACORS when compared to the analytical results were 24% for both. Fat was the nutrient which demonstrated higher non-compliance percentage from all three tolerance limits after protein (LACORS and leeway ± 20%) and carbohydrate (Food Act). There were 16%, 34% and 26% of fat content on the labels which did not comply with the tolerance limits of Food Act, leeway ± 20% and LACORS respectively. Therefore, this showed that the tolerance limit by leeway ± 20% was the most stringent regulation to comply with, followed by LACORS and lastly, Food Act, which was the most lenient regulations which allows food producers to comply more easily.

Overall protein demonstrated the highest percentage of non-compliance, followed by fat, carbohydrate and energy. The value of protein analysed in most of the products was not as high as other nutrients, therefore the percentage of difference would be more significant compared to the rest. In addition, energy was the nutrient which showed better compliance (energy is the summation of fat, carbohydrate and protein and the reading will be higher than the result apparently).

4.4 Current Enforcement Practice for Nutrition Labelling Regulations

The findings about interview session will be further discussed at Chapter 5, section 5.2.3.

CHAPTER 5: DISCUSSION

5.1 Precision of Declared Values on Nutrition Label

Based on the study, the results showed that the accuracy of nutrition facts on the label of prepackaged food sold in Malaysia was less satisfactory as compared to the researches done previously in other countries. According to the previous studies conducted by Fabiansson, 2006, less than 10% of the products showed non-compliance for energy, 20% of the products declared for protein were non-compliance, non-compliance for fat was 41% and about 23% of carbohydrate was also non-compliance. The compliance guideline was applied using leeway ± 20% and by using the same compliance guideline, 11% of prepackaged food was non-compliance for energy and the percentage of non-compliance for fat, carbohydrate and protein were 34%, 24% and 47% respectively (Table 5.1).

Table 5.1: Precision comparison of non-compliance products for current and previous studies using guideline leeway ± 20%

	Percentage of Non-compliance (%)	
Nutrients	**Fabiansson, 2006[a]**	**Current Research 2016[b]**
Energy	10	11
Fat	41	34
Carbohydrate	23	24
Protein	20	47

[a] Based on average analysis of 70 samples with 5 replicates per sample.
[b] Based on average analysis of 100 samples with 3 replicates per sample.

By comparing with similar study conducted in 2010 by Food Safety Authority of Ireland (FSAI) and using the tolerance guideline of LACORS, the current research showered worse percentage of compliance for all parameters (Table 5.2). Non-compliance of nutrient declaration for protein and carbohydrate were 4.5% for both parameters (FSAI study) whereas there were 24% and 32% of non-compliance for carbohydrate and protein respectively for the current research findings. The non-compliance for fat was 14.6% and 26% as stated in the report of FSAI and current research respectively. LACORS did not provide tolerance guideline for energy, consequently there is no data shown. However, the non-compliance for energy of current research was 11% if it is based on the guideline of ± 20% (tolerance of labelled value ± 20% for declared nutrient more than 5%).

Table 5.2: Precision comparison of non-compliance products for current and previous studies using guideline of LACORS

	Percentage of Non-compliance (%)	
Nutrients	**FSAI, 2010**[a]	**Current Research 2016**[b]
Energy	NA[c]	11
Fat	14.6	26
Carbohydrate	4.5	24
Protein	4.5	32

[a] Based on average analysis of 89 samples with 3 replicates per sample.
[b] Based on average analysis of 100 samples with 3 replicates per sample.
[c] Tolerance guideline for energy not provided by LACORS.

There were no similar studies discovered on compliance for nutrition declaration on prepackaged food by using one-way approach tolerance limit (which is the same as tolerance limit in the Food Act 1983). However, the prepackaged food showed the best compliance when using one-way approach tolerance limit among the three tolerance limits applied in this study.

Table 5.3: Ratio of nutrient declaration and analytical values for cereal and breakfast

Product's Name	Ratio (%)			
	Energy	Fat	Carbohydrate	Protein
Munchy Oat Krunch	100	101	97.7	110
Gardenia Delicia Roll Krim Jagung	206	185	222	202
Jacob's Oatmeal with Apricot	97.8	92.4	97.9	119
Mayora Wonder Wheat Chocolate Sandwich	103	116	93.3	104
Tesco Maple and Pecan Crisp	93.6	70.8	103	114
Mighty White Sweet Corn Cream Roll	97.9	98.7	98.7	89.8
Crisp Coarse Grain Pies	74.7	46.8	201	39.1
Quacker Oat Cereal Drink (3 in 1) chocolate	98.9	99.6	98.1	148
Nestle Nestum 3 in 1 original	101	76.7	107	103
Gardenia Delicia Bun Sambal Bilis	97.4	87.2	99.7	128
Kellogg's Coco Loops	315	240	311	455
Kellogg's Special K Red Berry Cereal Bar	103	99.8	104	105
High 5 Double Crème Espresso & Krim	92.3	93.8	86.0	148

Table 5.4: Ratio of nutrient declaration and analytical values for milk and dairy products

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
Dutch Lady Full Cream Milk	105	101	119	97.2
Marigold Low Fat Yogurt	89.3	97.9	83.9	102
Anchor Cheddar Cheese Slice	106	102	117	109
Laughing Cow Belcube Cheese Spread	107	102	151	106
Dutch Baby Langkah 1 Rumusan Bayi	95.5	73.0	112	112
F&N Magnolia High Calcium Low Fat Strawberry Flavoured Milk	85.0	107	68.8	126
Yakult Ace Light Cultured Milk Drink	103	100	95.5	145
Marigold HL Low Fat Milk	110	104	105	112
Nestle Fat Free Original Yogurt	112	280	106	117
Marigold HL Low Fat Chocolate Flavoured Milk	103	193	83.4	107
Dairy Champ Evaporated Creamer	106	94.9	115	127
Marigold Krimer Manis	103	89.0	108	132

Table 5.5: Ratio of nutrient declaration and analytical values for flour confection

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
Munchy Lexus	99.4	95.1	101	123
Cadbury Zip	97.4	89.0	109	111
Apollo Layer Cake	87.4	120	64.8	62.8
Julie's Peanut Butter	99.6	91.6	105	119
Bee Hiang Biscuit Jerry Gula	111	162	86.6	97.7
Gardenia Twiggies	107	110	106	50.3
Mighty White Cupcakes	94.4	88.2	101	99.3
Munchy Cream Crackers	99.5	97.4	95.7	137
IKO Digestive Biscuits	100	119	85.4	130
Senah Kuih Semprit	107	124	89.3	155
ORI Sarapan Coklat Puff	127	95.6	93.2	120
ORI Sarapan Lemon Puff	101	118	90.4	105

Table 5.6: Ratio of nutrient declaration and analytical values for canned meat, fish and vegetables

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
Adabi Sambal Ikan Bilis	111	105	385	58.1
King Cup Sardine	97.6	83.0	162	97.1
Ayam Brand Baked Beans	92.9	400	104	110
Vono Mushroom Soup	106	156	90.8	113
Smiling Fish Ikan Sardin Goreng Dalam Sos Cili	94.8	74.8	80.7	136
Ayam Brand Tuna Hot Mayonnaise	92.2	68.7	159	128
Ayam Brand Black Beans Mackerel	111	87.5	495	83.1
Sunstar Anchovies Sambal	95.7	75.9	104	183
Sunstar Beef Curry with Potatoes	56.2	35.4	49.3	108
Yeos Sambal Udang	93.5	85.2	78.1	156

Table 5.7: Ratio of nutrient declaration and analytical values for canned fruits and various fruit juices

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
Lee Pineapple in Syrups	109	100	111	96.7
Sunkist Orange Fruit Drink	102	100	108	100
Marigold Peel Fresh Tropical Mango	96.1	100	38.0	46.3
Drinme Orange Fruit Drink with Jelly	50.6	100	54.2	100
Tamek 100% Apple Juice with 100% Apfelsaft	93.6	100	93.6	100
Nutrico Lychees in Heavy Syrup	49.0	100	45.1	200
Ayam Brand Fruit Cocktail	66.5	100	66.8	243
Sew Mandarin Oranges	167	100	126	200
Ayam Brand Snacky Nanas	99.7	100	101	305
Marigold Peel Fresh Mixed Blackcurrant Cranberry Juice Drink	80.9	100	76.9	50.0

Table 5.8: Ratio of nutrient declaration and analytical values for snacks and indulgence food

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
Jack'n Jill Potato Chips	91.3	77.1	119	90.3
Pagoda Baked Cashew Nuts	101	94.8	124	88.8
M&M Milk Chocolate Candies	100	94.9	107	116
Kow Kow Deep Fried Salted Green Peas	109	85.8	132	97.7
Miaw Miaw Green Pea Snacks	106	122	107	53.2
Miaw Miaw Hot & Spicy Flavoured Prawn Crackers	86.1	38.3	119	90.9
Cap Pinggan & Keropok Ikan Segera	107	133	81.9	107
Nestle Mat Koll Ice Cream (Chocolate Strawberry)	120	75.8	157	107
Nestle Mat Koll Icy Grape & Lemon	119	100	119	100
Wall's Solero Split	142	151	134	353
Lay's Stax BBQ Potato Chips	91.8	71.7	122	51.5
Real Potato Chips Hot & Spicy	96.6	86.0	114	44.3
Wasabi Green Peas	104	122	104	72.5
Real Potato Chips Hot & Spicy (China)	106	113	106	34.0
Wasabi Broad Beans	97.8	87.6	102	106
Nongshim Shrimp Flavoured Crackers	93.9	93.6	99.5	83.3
Karamucho Hot Chilli Potato Chips	94.5	75.1	108	119
Rota Prawn Crackers	92.9	72.9	107	96.6
Lay's Masala Potato Chips	94.7	73.1	130	76.7
Cadbury Dairy Milk Chocolate	101	98.0	100	102

Table 5.9: Ratio of nutrient declaration and analytical values for coffee, tea and other hot beverages

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
Old Town 3 in 1 Coffee	94.2	114	85.5	121
Indocafe 3 in 1 Coffeemix	97.3	81.6	102	95.0
Cadbury Hot Chocolate	102	97.1	104	88.2
Wonda Premium Coffee (Mocha)	90.8	90.9	90.6	115
Super Nutre Milk Instant Soymilk Powder	105	85.6	114	140
Aik Cheong Coffee Mixture	99.1	35.4	98.4	124
Postcode Premium 3 in 1 Milk Tea	96.8	93.3	880	565
Nescafe Milk Coffee Drink	102	99.4	96.8	168
Nescafe Blend & Brew	97.9	87.7	99.1	134
Promex Chocomex Malted Chocolate Drink	117	83.7	100	122
Homesoy Instant Soya Milk	99.0	62.5	109	126
Nescafe Ipoh White Coffee	106	105	103	136
Superior Ipoh Original White Coffee	101	106	99.8	90.6

Table 5.10: Ratio of nutrient declaration and analytical values for jam, kaya and spread

Product's Name	Ratio (%)			
	Energy	**Fat**	**Carbohydrate**	**Protein**
High 5 Pandan Kaya	105	182	88.5	96.8
Lady's Choice Mentega Kacang Lapisan Coklat Susu	88.7	67.6	118	147
Yeo's Seri Kaya Original	103	110	101	126
Nona Kaya Coconut Jam	105	96.7	103	170
Moonlight Peanut Butter Creamy	89.7	93.8	137	119
Sunstar Pineapple Jam	102	100	102	185
Homax Coconut Spread	120	124	120	118
Gardenia Delicia Hazelnut Chocolate Spread	99.1	91.6	103	157
Raya Sri Pandan Kaya	104	458	95.9	87.0
Heinz Strawberry Jam	104	100	106	264

Table 5.11: Comparison of declared nutrients on nutrition information and averaged analytical results

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
1	Gardenia Delicia Roti Krim Jagung	168	347	69.4	6	11.1	59.6	24	53.2	75.6	4.2	8.5	67.7
2	Postcode Premium 3 in 1 La Tea Milk Tea	464	449	3.29	16.3	15.2	6.98	7.77	68.4	159	1.7	9.6	140
3	Miaw Miaw Hot & Spicy Flavoured Prawn Crackers	478	412	14.9	20.4	7.81	89.3	66.8	79.2	16.9	6.8	6.12	10.5
4	Aik Cheong Coffee Mixture Bags	400	396.3	0.929	10	3.54	95.4	80	78.71	1.63	10	12.4	21.4
5	Wall's Solero Split (Lime and Vanilla Flavoured Confection)	65	92	34.8	1.4	2.11	40.5	11.9	15.89	28.7	0.7	2.47	112

The leniency of this tolerance limit elicited asymmetric percentage of compliance. For instance, protein declaration on labelling is considered compliant to the Food Act 1983 Schedule 18 when the analytical result is ≥80%; hence when referring to Table 4.2, the analytical value for protein content for Gardenia Delicia Roll Krim Jagung was 8.5g/100g whereas this was stated 4.2% on the nutrition facts panel. The ratio was 202% as shown in Table 5.3 and this complied with the regulation of ≥80% but the RPD for these two readings was 67.7% and this has exceeded the tolerance limits of ± 20%. Another example for the same situation can be seen by referring to Table 4.2, the ratio of protein for Postcode Premium 3 in 1 Milk Tea was 565% (Table 5.9) and this was a significant figure that showed a vast difference between declared and analytical values, yet it still complied with the regulation of the Food Act 1983. Obviously, this product neither complied with limits of leeway ± 20% nor LACORS because the RPD was 140% (Table 4.2).

According to the Food Act 1983, the declared value for fat must be less or equal to 120% as stated in compliance guidelines. The ratio of Miaw Miaw Hot & Spicy Flavoured Prawn Crackers under the category of snacks and indulgence food and Aik Cheong Coffee Mixture under the category of coffee, tea and other hot beverages were less than 40% (Table 5.8 and 5.9). This provided a good indication that consumers were actually consuming less fat content compared to what was stated on the label. However, the RPD between the prawn crackers and the coffee mixture were 89.3% and 95.4% respectively as seen in Table 4.2. The significant RPD might increase the sceptical feelings from the consumers on the trustworthiness of the information of these products. Therefore, the asymmetric of the tolerance limits could cause confusion among consumers.

5.2 Reasons That Caused Non-compliance

5.2.1 Method of Analysis

There are many methods used to determine the nutrient contents in food products, whether it is the standard method such as AOAC or the manufacturers' in-house method. For instance, fat content of noodle can be determined by using soxhlet extraction with or without acid hydrolysis. If the noodle contains nuts, the fat content determined using direct soxhlet extraction may not be able to extract oil from the sample without acid hydrolysis completely (AOAC 17th Ed., 1982). Some products such as soy sauce are oil-less and in order to increase the smooth mouth-feel sensation, manufacturers will use encapsulation technology to make the soy sauce appeared as light as others with no oil separation as the oil content encapsulated in the soy sauce would not be detected without acid hydrolysis. According to Kleyn et al., 2001, fat concentration was underestimated between 1-2% when sample is taken by weighing instead of pipetting in volume. The RPD of Wall's Solero Split (Lime and Vanilla Flavoured Confection) was 40.5% (Table 4.2) as the researcher conducted this sample by melting the sample; thus the sample taken was in ml whereas the manufacturer might use non-melted sample and sample is taken by weighing. Instead of the standard methods such as AOAC, some analysts may use other method such as near-infrared reflectance spectroscopy (Albanell et al., 2003) to determine the fat and protein content in dairy products.

For the determination of protein, Kjeldahl method is commonly used by the industries. This method is more cost effective compared to combustion method. Kjeldahl method consists of three steps of nitrogen content determination which are digestion or decomposition of samples. The second step is distillation and the last step is titration. While combustion method is direct determination of the nitrogen content, thus the errors of analysis will decrease consequently. Therefore, it is crucial to choose the most precise and accurate or standard method to avert false declaration of nutrients.

Sample preparation and homogeneity of the samples are another important factor that will produce false result. Canned meat, fish and vegetables product and canned fruits and various fruit juices showed poor accuracy among the analysed food categories. According to Joslyn, from her edited books of <<Method in Food Analysis>>, solids and liquids portion are required to be separated by draining off prior to homogenization of samples. The canned food samples were prepared in accordance to Joslyn in this study and it was observed that the nutrients content especially protein from the analysis was higher than the label. Food manufacturers might not be using sample preparation method as suggested by Joslyn, hence the protein content on the label was lower than the analysis due to dilution factor (sample is required to be diluted into solution prior to determination using Kjeldahl method).

Some prepackaged food samples contain not only single material. For instance Ayam Brand Black Beans Mackerel contained mackerel fish and black beans; and Sunstar Beef Curry with Potatoes contained beef, potatoes and chilli paste. The non-homogeneity of samples would also produce inconsistency in analytical results.

5.2.2 Common Practice of Manufacturer in Nutrition Information Declaration

After interviewing a few prepackaged food manufacturers who produced soy bean milk, canned meat, 3 in 1 instant coffee, bread, snacks and ice confection, it was found that since the formulation of production has no changes, the nutrition information remains the same as the procedures they used to produce the nutrition information included analysis results from some accredited laboratories as well as calculation from certificate of analysis provided by their suppliers.

Results obtained from analytical laboratories can produce the most accurate and precise results since the results provided were under the supervision of standard of Malaysia (provided the laboratory complies with ISO 17025). The nutrients were calculated from the dosage of ingredients used (the nutrients value extracted from the certificate provided by the suppliers) might be accurate as well if their suppliers' results were precise and accurate. However, keeping the nutrition information for ages when the formulation remained unchanged was less reliable. As mentioned in Chapter 2, the composition of food would change according to climate and soil condition. This method was commonly used by those small scale manufacturers. Their technique and formula were either inherited or newly developed, thus they would have to save the cost of production. Therefore, they were not able to send their products to accredited laboratories frequently or did not have food technologist or chemist in their premise to assist them in the calculation for nutrient declaration. For example, the product Postcode Premium 3 in 1 La Tea Milk Tea has made a very obvious mistake in the nutrition fact panel (Table 4.2). The RPD of carbohydrate and protein of this product were 159% and 140% respectively. Nutrition values declared on label was 7.77g/100g and 1.7g/100g for carbohydrate and protein; whereas the analytical values were 68.4g/100g and 9.6g/100g respectively. Conversely, the energy and fat content showed satisfactory RPD. The carbohydrate and protein might be declared based on the diluted sample (thus the labelling values were much lower than analytical) whereas energy and fat were declared as powder (without dilution). This mistake could be avoided if the sample is sent to an accredited laboratory or the manufacturer hires a qualified food technologist to be in-charge on the quality.

5.2.3 Lenient Enforcement of Regulation

Interview sessions were also conducted with person in charge from both the government and private sectors in order to understand the practice they execute to control the accuracy of nutrition labelling (Table 5.12).

Table 5.12: Position, department and company of interviewees

No	Name	Position	Department/ Company
1	Ms. Norliza Binti Zainal Abidin	Assistant Director	Special Food Group Section of Food Safety and Quality Division (Ministry of Health Malaysia)
2	Ms. Chin Yin Yin	Senior Manager	Quality and Halal Quality, Hygiene and Halal Department of Aeon Big (M) Sdn. Bhd.
3	Ms. Nur Hazwani Bt. Mohammad	Assistant Manager	Quality Management, AEON Malaysia
4	Anonyms	Assistant Manager	-

Interview conducted on 19 May 2016 with Ms. Norliza Binti Zainal Abidin, 23 May 2016 with Ms. Chin Yin Yin and Anonyms and 24 Mav 2016 with Ms. Nur Hazwani Bt. Mohammad

According to regulation 397 from the Food Act and Regulations 1985, any person who contravenes or fails to comply with any provisions of these regulations commits an offence. Any person who commits an offence against these regulations for which no penalty is provided by the Act shall, on conviction, be liable to a fine not exceeding five thousand ringgit or imprisonment for a term not exceeding two years.

According to the interviewee, Ms Norliza Binti Zainal Abidin who is the Assistant Director of Special Food Group Section of Food Safety and Quality Division from Ministry of Health Malaysia, the division provides food labelling advisory services and food labelling to industries for ensuring the food labels to be in compliance with the Food Act and Regulations 1985. She also mentioned that Standard and Codex Division of Food Safety and Quality Division from Ministry of Health Malaysia are in-charge on the quality of nutrition label of prepackaged food.

There are a few hypermarket chains in Malaysia where the hypermarkets possess a quality department to ensure the quality of the products that are sold in the hypermarket. One of the main functions of the quality department is to ensure that the nutrition labels provided by the distributors or manufacturers are accurate. According to the Senior Manager of Quality and Halal Quality, Hygiene and Halal Department of Aeon Big (M) Sdn. Bhd., Ms. Chin Yin Yin, their company's practice is to obtain nutrition analysis certificate from an accredited analytical laboratory (which is provided by the manufacturers) before they can list their products in Aeon Big. They require more stringent assessment on the products especially when those products have nutrition claims. However, they do not conduct any spontaneous cross check on the accuracy of the declaration of nutrition labels.

The practice of AEON Malaysia showed similar practice as Aeon Big, according to Ms. Nur Hazwani Bt. Mohammad (Assistant Manager of Quality Management). Their corporation does not set up any nutrition labelling criteria for manufacturers to list the products in their hypermarkets. Another hypermarket (whose name, position and company name preferred to be anonymous) does not have any special practice to ensure the accuracy of the nutrition labels of the products sold in their hypermarkets; neither non-scheduled cross check are conducted nor do they receive analytical reports from the manufacturers (Table 5.13). Therefore, the practice in ensuring the accuracy of declared values of nutrition label is incomplete either from the government or the private sectors.

Table 5.13: Enforcement practice from hypermarkets and government sector.

Enforcement Practice	AEON	AEON Big	Anonyms	FSQ MOH
Non Schedule Cross Check	Not available	Not available	Not available	Not available
How to ensure the accuracy of nutrition labels	Not available except for products which have nutrition claims must provide third party test certificates.	Manufacturers are required to provide nutrition label analysis certificates before listing. Products with claims must provide test certificates from accredited labs.	Not available	Food labelling advisory service provided to industries.
What are the actions taken for non-compliance	Not available	Rejected for listing	Not available	Fine not exceeding five thousand ringgit or imprisonment for a term not exceeding two years

CHAPTER 6: CONCLUSION

6.1 Overview

The purpose of this study was to determine the reliability or accuracy of declared nutrient values on prepackaged food. The results showed that the amount of products with 0% RPD for energy, fat, carbohydrate and protein were 2%, 11%, 1% and 4% respectively. It was also observed that 1% of the products with declared values of energy is totally different with analytical values, whereas 5% declared values of fat, 4% declared values for carbohydrate and 7% declared values for protein were 100% different from analytical values.

When comparing the compliance with the tolerance limits in the Food Act 1983 and Regulations, the tolerance limit stated in the Food Act 1983 is one-way approach comparison, whereby the declared nutrient values on prepackaged food for energy, fat and carbohydrate must be ≤120% to comply with and ≥80% for protein for compliance. A total of 100 samples with 3 replicates of each sample were analysed on the core nutrients (energy, protein, fat and carbohydrate). The number of compliance for the products was 66% when compared with tolerance limits of the Food Act 1983 and Regulation, Schedule 18C.

Other than tolerance guideline of the Food Act 1983, this research has also studied the compliance of prepackaged food by comparing with tolerance guidelines of leeway ± 20% (two-way approach) and LACORS. Results showed that only 27% of the products complied with leeway ± 20% and 44% of the products complied with LACORS. Therefore, these products would encounter difficulties when being exported to countries applying these guidelines. As a result, their products might be rejected from being sold in these countries.

The previous studies related to the products' compliance have been carried out in Australia and Ireland using tolerance guidelines of leeway ± 20% and LACORS respectively. Current research illustrated that Malaysia's prepackaged food has worse percentages of compliance compared to Australia and Ireland prepackaged food. This might be due to unavailability of non-scheduled cross check for food labels as tolerance limits compliance surveillance is not a common practice, let alone a standard procedure. At the same time, the results also illustrated that the quality departments of supermarkets or hypermarkets do not have any enforcement policies to ensure the accuracy of declared nutrient values.

In this research, all food samples were stratified into eight categories. Four categories required mandatory nutrition labelling according to the Food Act 1983 (prepared cereal and bread, milk and dairy products, flour confection and canned meat, fish and vegetables) and the other four categories are voluntary basis (snack and indulgence food, coffee and other hot beverages, canned fruits and various fruit juices and lastly, jam, kaya and other spreads). Canned meat, fish and vegetables were the most difficult prepackaged food to comply with all three guidelines. There was 100% of analysed products did not comply with leeway ± 20%, 90% did not comply with LACORS and 60% did not comply with Food Act 1983.

Among the core nutrients analysis, the declared values for protein show the worst percentage of compliance. There was 32% of protein content on labels that did not comply with the analytical values when compared with tolerance limits of the Food Act 1983, whereas 47% and 11% did not comply with leeway ± 20% and LACORS.

6.2 Suggestions for Improving Accuracy of Nutrition Label

"Dis-moi ce que tu manges, je te dirai ce que tu es", which means that "tell me what you eat and I will tell you what you are". This was quoted from a French politician, Anthelme Brillat-Savarin which he wrote in his book *Physiologie du Gout* (1825). In the east, China's Soong Dynasty's philosopher said, "disasters exited from mouth; illnesses entered from mouth either". Back to contemporary moment, the American writer Michael Pollan posted that Americans would transform into corn in the future. He raised this because Americans are consuming too much food which is derived from corn such as syrup, fast food and et cetera. Therefore, regardless of the distance stretching across geographical regions or transcending time over epoch, human's health is jeopardized by the diet intake or eating lifestyle. All countries' authority has set regulations on tolerance limits on nutrition labels which are suitable and appropriate to that specific country in order to alleviate public health issues such as NCD or obesity pandemic. Furthermore, there is no standardization of tolerance limit approach. Food producers must be honest with their products and should have put extra efforts to provide reliable nutrition labels on their prepackaged food products and to ensure that the nutrition labels complied with the import countries' regulations. Therefore, they can avoid losses and provide credibility of nutrition information to consumers by sending their products to accredited laboratories to obtain reliable nutritional values.

In addition, policy makers may suggest for the government to draft new regulations such as providing tax relief for food producers on nutrition labelling cost. Government should be actively involved in international nutritional labelling meeting such as the one organized by Codex to raise the issue on harmonization of nutrition labelling guidelines and regulations (based on scientific evidence) which would reduce production cost by reducing the overall complexity of multi-markets compliance. For instance, governments and international organizations are cooperating harmoniously to ensure that the processed food either for import or export activities carry accurate nutrition information (Kasapila et al., 2013).

Additionally, suitable nutrition labelling awareness programmes should be held in primary or high schools where well known people (celebrities for instance) are invited to give speeches related to the programmes which is to introduce as well as to increase the awareness on nutrition labelling as suggested by Tarabella et al in 2012.

Subsequently, further investigation regarding the accuracy of other nutrients such as sodium and trans fat which are detrimental to human's health can also be conducted as well as other supplements where the contents of nutrients or minerals which have been declared on the package must also be tested.

Lastly, provision of clear and accurate nutrition information is one important way to help consumers adhere to the guidelines and make informed choices (Roberto et al., 2014). It is hoped that this research provides some information which can be used by policy makers to draft new policies related to the accuracy of nutrition label in the future. Consequently, consumers can enjoy clarity and credible nutrition labels which are beneficial to their health as well as their daily expenditure.

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APPENDIX

APPENDIX A: METHOD OF ANALYSIS

A1 Determination of Energy

Total energy is determined by calculation from the results obtained from the analysis of fat, protein and carbohydrate.

Total energy (kcal/100g) = (%Fat x 9) + (%Protein x 4) + (%Carbohydrate x 4)

A2 Determination of Carbohydrate

Total carbohydrate is determined by difference of the results obtained from analysis of fat, protein, moisture and ash.

Total carbohydrate (%) = 100 – (%Protein + %Fat + %Moisture + %Ash)

A3 Determination of Fat

A3.1 Mojonnier Ether Extraction Method

Matrix: Beverages, Dairy Products, Mayonnaise, Ice-cream, Coconut Milk, Juices

Apparatus:

Mojonnier style extraction flask, weighing dishes, analytical balance, dehumidifier, hot plate, oven, water bath.

Reagents:

Ammonium Hydroxide (ACS grade), Hydrochloric Acid (AR grade), Ethanol 95%, Ethyl Ether (ACS grade), Petroleum ether (ACS grade, boiling range 30-60°C.

Sample Preparation:

(A) Werner-Schmid Process (Acid Extraction)

Matrix: High protein samples, ice-cream

Method:

Weigh 1g (10ml if sample in liquid form) of sample followed with 2ml of water. Add 10ml conc. HCl, homogenized it and warm it at water bath for 15 minutes.

(B) Rose-Gottlieb Method (Alkaline Extraction)

Matrix: All milk and milk products, high sugar sample, liquid samples

Method:

Weigh 1g (10ml if sample in liquid form) of sample followed with 1.5ml ammonium hydroxide solution. Add 3 drops of phenolphthalein, homogenized and warm it at water bath.

Procedure:

(A) Weighing dish preparation

Number clean weighing and pre-dried under same condition that will be used for final drying after fat extraction. Be sure that all surfaces where weighing dishes will be placed (i.e., hot plate, desiccator etc.) are clean and free of particles. At the end of oven drying, place pans in room temperature desiccators and cool to room temperature. On the same day as fat extraction, weigh dishes to nearest 0.1mg and record weight. Check balance zero after weighing each pan. Protect weighed pans from contamination with extraneous matter.

(B) Fat Extraction

Add 10ml ethyl alchohol, stopper with H_2O-saoked cork, shake flask for 1.5s. for the first extraction, add 25ml diethyl ether, topper with cork and shake flask very vigorously for 60s, release built-up pressure by loosening stopper as necessary. Add 25ml petroleum ether, stopper with cork, and repeat vigorous shaking for 60s. Let it stand to obtain clear separation of aqueous (bright pink) and ether phases.

Decant ether solution into weighing dishes. When ether solution is decanted into dishes, be careful not to pour over any suspended solids or aqueous phase into dishes. Ether can be evaporated at ≤100°C from dishes while conducting second extraction. For second extraction, add 5ml ethyl alchohol, stopper with cork, shake vigorously 15s. Next, add 15ml ethyl ether, replace cork, and shake flask vigorously for 1min. add 15ml petroleum ether, stopper with cork and repeat vigorous shaking for 1 min. Let it stand to obtain clear separation of aqueous and ether phase.

If interface is below neck of flask, add H_2O to bring up level about half way up neck. Add H_2O slowly down inside surface of flask so that there is minimum disturbance of separation. Decant ether solution for second extraction into same dishes used for first extraction.

For third extraction, omit addition of ethyl alchohol and repeat procedure used for second extraction. Completely evaporate solvent in hood in hotplate at ≤100°C (avoid spattering). Dry extracted fat and dishes to constant weight in forced air oven at 100±1°C (≥30 min).

Remove dishes from oven and place in desiccator to cool to room temperature. Record weight of each dishes and fat. Run pair of reagent blanks, replace sample with 10ml H_2O and run test as normal. Reagent blank should be <0.0020g residues. If reagent blank s are negative use negative number in calculation. Negative blank usually indicates that dishes were not completely dried at start of determination or the balance calibration shifted between weighing of empty pans and pans plus fat. Cause of negative blank should be identified and corrected.

Analysis conducted in triplicate. The relative percentage difference for all triplicates must be within the tolerance of ±20% difference. If the results are not within the tolerance level, it must be repeated.

A3.2 Soxhlet Extraction without Acid Hydrolysis

Matrix:

Noodles and pastas, fruits and vegetables.

Apparatus:

Soxtet Extraction System (FOSS Soxtet 2055), cellulose extraction thimbles, extraction vessels, analytical balance, dehumidifier.

Reagents:

Petroleum Ether ACS Grade, boiling range 30-60°C.

Procedure:

1. Samples are ground into fine particles homogeneity.
2. Suitable amount of samples are weighed accurately into a cellulose thimble.
3. Extraction vessels are measured.
4. 80ml of Petroleum Ether is poured into the extraction vessels.
5. The thimbles with double folded filter papers and samples are fit onto the extraction system.
6. Extraction vessels and thimbles are fit at the right position of the extraction system.
7. Extraction begun from boiling at 130°C for an hour to immersion at 100°C for 90 mins, rinsing for 30 mins and drying for 1 min.
8. Extraction vessels transferred to oven to remove excessive of moisture for 15 minutes.
9. Extraction vessels transferred to dehumidifier to cool down to room temperature.

   Extraction thimbles with oil are weighed.
10. Triplicate conducted for the analysis, repeat the sample if the triplicate results not within the range of ±20% of relative percentage difference.

A3.3 Soxhlet Extraction with Acid Hydrolysis

Matrix:

Meat products, cereals and grains, cocoa products.

Apparatus:

Soxtet Extraction System, cellulose extraction thimbles, extraction vessels, analytical balance, dehumidifier.

Reagents:

Petroleum Ether ACS Grade, boiling range 30-60°C, 8 N Hydrochloric acid (HCl),

0.1N Silver Nitrate ($AgNO_3$)

Procedure:

1. Samples are ground into fine particles homogeneity.
2. Suitable amount of samples are weighed accurately into a 250ml beaker.
3. 45ml of boiling water added slowly into the beaker while stirring.
4. 55ml 8N HCl, antibumping granules are added into the beaker.
5. Samples are boiled gently for 15 minutes and covered with watch glass.
6. Watch glasses are rinsed with 100ml of water.
7. Digested samples are filtered through double folded filter paper.
8. The beakers are rinsed few times with water.
9. The double folded filter papers are rinsed with hot water until are freed from chloride. (This can be determined by addition of 0.1N $AgNO_3$.)

10. The wet double folded filter papers with samples are transferred into thimbles and dried in oven for 6-18 hours at 100°C.
11. Extraction vessels are measured.
12. 80ml of Petroleum Ether is poured into the extraction vessels.
13. The thimbles with double folded filter papers and samples are fit onto the extraction system.
14. Extraction vessels and thimbles are fit at the right position of the extraction system.
15. Extraction begun from boiling at 130°C for an hour to immersion at 100°C for 90 mins, rinsing for 30 mins and drying for 1 min.
16. Extraction vessels transferred to oven to remove excessive of moisture for 15 minutes.
17. Extraction vessels transferred to dehumidifier to cool down to room temperature.
18. Extraction thimbles with oil are weighed.
19. Triplicate conducted for the analysis, repeat the sample if the triplicate results not within the range of ±20% of relative percentage difference.

A4 Determination of Protein

Apparatus:

Digestion block (VELP DK20), digestion tube 250ml, distillation unit (Buchi 320), titration burette 25ml (Class A)

Reagents:

Sulfuric acid – 95-98%, 5% copper sulfat solution, potassium sulfate (AR Grade), boiling chips, methyl red/ bromocresol green indicator solution, 50% sodium hydroxide solution, 4% boric acid solution, 0.1N standardized hydrochloric acid.

Procedure:

1. Samples are ground into fine particles homogeneity.
2. Weigh suitable amount of sample on a weighing paper.
3. Transfer the weighed sample into digestion tube. Then add 3g potassium sulfate, 1ml 5% copper sulfat solution and 8-10 boiling chips. Lastly add 20ml concentrated sulfuric acid.
4. Set block at low initial temperature to control forming (ca 180-230°C).
5. Place tubes with aspirator connected in block digestor, suction should be just enough to remove fumes.
6. Digest for 30 mins. Then increase temperature to 410-430°C and digest till clear.
7. At the end of digestion, digested sample should be clear and free from undigested materials.
8. Cool to room temperature (ca 25 min).

9. For distillation, place 50% sodium hydroxide into the digestion tube. Adjust volume dispensed to 55ml.
10. Place 250ml conical flask containing 50ml boric acid with indicator on receiving platform, with tube from condenser extending below surface of boric acid.
11. Steam-distill until ≥150ml distillate is collected.
12. Titrate boric acid with standardized 0.1000N hydrochloric acid to first trace pink.
13. Record the end point to at least nearest 0.05ml.
14. Triplicate conducted for the analysis, repeat the sample if the triplicate results not within the range of ±20% of relative percentage difference.

A5 Determination of Moisture

Apparatus:

Air oven, aluminium dish.

Procedure:

1. Dry the empty aluminium dish in air oven 100^{o} C for 1 hours.
2. Cool in desiccators for 30 min and record the weight as blank dish.
3. Dry about 1g of sample in aluminium dish in air oven at 100C for 5 hours.
4. Cool in desiccator for half hour and record the weight.
5. Dry the sample again in oven for an hour.
6. Cool for 30 min and record weight.
7. Repeat drying in oven for an hour until constant weight is gained.

8. Repeat loss in weight as moisture.
9. Triplicate conducted for the analysis, repeat the sample if the triplicate results not within the range of ±20% of relative percentage difference.

A6 Determination of Ash

Apparatus:

Furnace 500°C, porcelain dish 50ml

Procedure:

1. Ignite the porcelain dish in furnace at 500°C for 30 min.
2. Cool the dish in desiccator and record the weight of the porcelain dish.
3. Weigh about 2g of sample into porcelain dish.
4. Place in oven at 100°C for 1 hour.
5. Transfer to furnace at 500°C for 5 hours.
6. Cool in desiccator and record the weight.
7. Repeat the ignition for period of 1 hour, cooling and weighing until a constant mass obtained.
8. Triplicate conducted for the analysis, repeat the sample if the triplicate results not within the range of ±20% of relative percentage difference.

APPENDIX B: Full Results of Comparison of Declared Nutrients on Nutrition Labels and Averaged Analytical Values

Table App. B: Comparison of declared nutrients on labelling and averaged analytical values for core nutrients

No.	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
1	Munchy Lexus	521	518	0.577	26.6	25.3	5.01	65.6	66.0	0.608	5.3	6.51	20.5
2	Cadburry Zip	530	516	2.68	29	25.8	11.7	57.4	62.6	8.67	7.7	8.58	10.8
3	Apollo Layer Cake	405	354	13.4	18.4	22.1	18.3	51.2	33.2	42.7	8.7	5.46	45.8
4	Julie's Peanut Butter	512	510	0.391	26.2	24	8.77	59.2	62.4	5.26	9.2	10.9	16.9
5	Munchy Oat Krunch	492	492	0	21.7	22	1.37	64.8	63.3	2.34	9.3	10.2	9.23
6	Jack 'n Jill Potato Chips (BBQ Flavour)	577	527	9.05	40.2	31	25.8	46.8	55.6	17.2	7.1	6.41	10.2
7	Vono Crunchy Mushroom Instant Soup	395	417	5.53	9	14	43.5	71.8	65.2	9.64	6.8	7.67	12.0
8	Pagoda Baked Cashew Nuts	560	565	0.907	38.7	36.7	5.31	33.2	41.3	21.7	19.6	17.4	11.9
9	Adabi Sambal Ikan Bilis	164	182	10.3	14.1	14.8	4.84	2.3	8.86	118	5.7	3.31	53.1
10	m&m Milk Chocolate Candies	490	491	0.281	21.6	20.5	5.23	66.7	71.4	6.81	4.6	5.32	14.5
11	King Cup Sardine in Tomato Sauce	105	102	2.45	4.7	3.9	18.6	2	3.24	47.3	14	13.6	2.90

Table App B: Continue

No.	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
12	Old Town 3 in 1 White Coffee	500	471	5.95	15.7	17.9	13.1	87.3	74.6	15.7	2.4	2.9	18.9
13	Indocafe 3 in 1 Coffeemix	440	428	2.73	10.7	8.73	20.3	82	83.6	1.93	4	3.8	5.13
14	Cadbury Hot Chocolate Drink	440	449	2.12	13.9	13.5	2.92	73.8	76.6	3.72	6.1	5.38	12.5
15	Wonda Premium Coffee (Mocha)	61	55	9.62	1.1	1	9.52	10.9	9.87	9.92	1.5	1.73	14.2
16	Dutch Lady Full Cream Milk	62	65	5.05	3.3	3.33	0.905	4.8	5.7	17.1	3.2	3.11	2.85
17	Marigold Low Fat Yogurt (Peach)	106	95	11.3	1.9	1.86	2.13	18	15.1	17.5	4.3	4.39	2.07
18	Kow Kow Deep Fried Salted Green Peas	420	460	8.98	19	16.3	15.3	43	56.7	27.5	22	21.5	2.30
19	Gardenia Delicia Roti Krim Jagung	168	347	69.4	6	11.1	59.6	24	53.2	75.6	4.2	8.5	67.7
20	Miaw Miaw Green Pea Snacks	465	493	5.78	18	21.9	19.5	62.7	66.97	6.59	13	6.92	61.0
21	Jacob's Oatmeal with Apricot	453	443	2.23	15.7	14.5	7.95	70.2	68.7	2.16	7.9	9.43	17.7
22	Miaow Miaow Hot & Spicy Flavoured Prawn Crackers	478	412	14.9	20.4	7.81	89.3	66.8	79.2	16.9	6.8	6.12	10.5
23	Anchor Cheddar Cheese Slices	300	318	5.91	24.8	25.4	2.39	3.1	3.62	15.5	17.3	18.8	8.31

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
24	Cap Pinggan dan Keropok (Keropok Ikan Segera)	482	513	6.31	24	31.8	27.9	56.8	46.5	19.9	9.6	10.3	7.04
25	Mayora Wonder Wheat Chocolate Sandwich	497	512	2.97	22	25.4	14.3	67	62.5	6.95	8	8.34	4.16
26	Bee Hiang Biskut Jerry Gula	448	498	10.6	15.9	25.7	47.1	69.5	60.2	14.3	6.6	6.45	2.30
27	Nestle Mat Kool Ice Cream (Chocolate and Strawberry Flavoured)	91	109	18.1	4.46	3.38	27.6	12	18.84	44.4	0.77	0.82	6.29
28	Nestle Mat Kool Icy Grape, Lemon and Lime Flavoured Ice Confection	65	77	17.4	0	0	0	16.2	19.34	17.7	0	0	0
29	Tesco Maple & Pecan Crisp	470	440	6.65	18	12.74	34.2	70.3	72.19	2.65	8	9.08	12.6
30	Ayam Brand Baked Beans in Tomato Sauce	100	93	7.34	0.4	0	200	17.9	18.61	3.89	4.2	4.62	9.52
31	Lee Pineapple Slices in Syrup	63	68	8.22	0	0	0	15.2	16.81	10.1	0.3	0.29	3.39
32	High 5 Pandan Kaya	307	321	4.45	5.5	10	58.1	60.9	53.87	12.3	4	3.87	3.30
33	Sunkist Orange Fruit Drink	32	34	6.65	0	0	0	7.9	8.55	7.90	0	0	0

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
34	Marigold Peel-Fresh Tropical Mango	49	47	3.40	0	0	0	30	11.4	89.9	0.8	0.37	73.5
35	Wall's Solero Split (Lime and Vanilla Flavoured Confection)	65	92	34.8	1.4	2.11	40.5	11.9	15.89	28.7	0.7	2.47	112
36	The Laughing Cow Belcube Cheese Spread	273	292	6.89	23	23.5	2.15	5	7.53	40.4	12	12.7	5.67
37	Dutch Baby Langkah 1 Rumusan Bayi	505	482	4.67	27	19.7	31.3	57.6	64.26	10.9	10.6	11.9	11.6
38	Cadbury Dairy Milk Chocolate	530	533	0.512	29.4	28.8	2.06	59.9	60.09	0.317	8.1	8.29	2.32
39	Lay's Stax Barbecue Flavoured Potato Crisps (USA)	536	492	8.54	32.1	23	33.0	57.1	69.44	19.5	3.57	1.84	63.9
40	Real Potato Chips Hot & Spicy Flavoured (USA)	531	513	3.50	31.5	27.1	15.0	57.1	65.13	13.1	4.7	2.08	77.3
41	Real Potato Stick Hot & Spicy (China)	515	545	5.69	30	34	12.5	55	58.09	5.47	5	1.7	98.5
42	Wasabi Green Peas (Japan)	431	448	3.93	11.6	14.2	20.2	66.7	69.32	3.85	14.9	10.8	31.9
43	Wasabi Broad Beans (Japan)	456	446	2.27	16.9	14.8	13.2	56.8	57.84	1.81	19.1	20.3	6.09

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
44	Nongshim Shrimp Flavoured Cracker (Korea)	532	499	6.33	24.9	23.3	6.64	68	67.7	0.501	5.7	4.75	18.2
45	Karamucho Hot Chilli Potato Chips (Japan)	536	506	5.70	35.7	26.8	28.5	53.6	57.8	7.58	7.14	8.46	16.9
46	Rota Prawn Cracker (Msia)	485	450	7.39	21	15.3	31.4	66	70.5	6.52	8	7.73	3.43
47	Lay's Masala Potato Chips (Pakistan)	520	492	5.44	32	23.4	31.0	49	63.6	25.9	9	6.9	26.4
48	Gardenia Twiggies Choc-A-Lot Choclate Sponch Cake	365	389.8	6.57	14	15.4	9.52	53.5	56.71	5.83	12.1	6.09	66.1
49	Mighty White Sweet Corn Soft Cream Roll	377	368.32	2.33	15.2	15	1.33	50.9	50.25	1.29	9	8.08	10.8
50	Mighty White Cup Cake	445	419.9	5.80	25.5	22.5	12.5	48	48.69	1.43	5.7	5.66	0.704
51	Munchy Cream Crackers	484	481.32	0.555	19.3	18.8	2.62	68.3	65.33	4.45	9.3	12.7	30.9
52	Super Nutre Milk Instant Soymilk Powder	406	426.9	5.02	13.9	11.9	15.5	44	50.05	12.9	21.3	29.9	33.6
53	Crisp Coarse Grain Pies (Milk Chocolate Cereal)	660	492.86	29.0	46.4	21.7	72.5	32.1	64.61	67.2	25	9.78	87.5

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
54	Aik Cheong Coffee Mixture Bags	400	396.3	0.929	10	3.54	95.4	80	78.71	1.63	10	12.4	21.4
55	Quaker Oat Cereal Drink (3 in 1 Chocolate)	404	399.79	1.05	6.7	6.67	0.449	78	76.48	1.97	5.7	8.46	39.0
56	Nestle Nestum 3 in 1 Original	388	392.54	1.16	4.2	3.22	26.4	69.5	74.49	6.93	16	16.4	2.47
57	F&N Magnolia High Calcium Low Fat Strawberry Flavoured Milk	68	57.8	16.2	1.5	1.6	6.45	11.2	7.71	36.9	2.5	3.14	22.7
58	Yakult Ace Light Cultured Milk Drink	57	58.96	3.38	0	0.2	200	13.3	12.7	4.62	1.1	1.59	36.4
59	Marigold HL Low Fat Milk	50	54.92	9.38	1	1.04	3.92	5.5	5.78	4.96	5	5.61	11.5
60	Nestle Fat Free Original Yogurt	54	60.36	11.1	0.1	0.28	94.7	9.7	10.25	5.51	3.6	4.21	15.6
61	IKO Digestive Biscuits	491	491	0	20.4	24.3	17.4	62.2	53.1	15.8	8.3	10.8	26.2
62	Postcode Premium 3 in 1 La Tea Milk Tea	464	449	3.29	16.3	15.2	6.98	7.77	68.4	159	1.7	9.6	140
63	Senah Kuih Semprit	506	540	6.50	24.3	30.2	21.7	67.2	60	11.3	4.5	6.99	43.3

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
64	Smiling Fish Ikan Sardin Goreng Dalam Sos Cili	178	168.79	5.31	7.1	5.31	28.8	15.3	12.35	21.4	13.2	17.9	30.2
65	Ayam Brand Tuna Hot Mayonnaise	165	152.11	8.13	11.4	7.83	37.1	3.4	5.41	45.6	11.7	15	24.7
66	Ayam Brand Black Beans Fried Mackerel	284	315.25	10.4	18.2	15.93	13.3	4.9	24.27	133	22.5	18.7	18.4
67	Sunstar Anchovies Sambal	253	242.02	4.44	17	12.9	27.4	18	18.68	3.71	7	12.8	58.6
68	Sunstar Beef Curry Potatoes	198	111.2	56.1	13	4.6	95.5	7	3.45	67.9	13	14	7.41
69	Yeo's Sambal Prawn	170	158.96	6.71	9.2	7.84	16.0	15.1	11.81	24.5	6.6	10.29	43.7
70	ORI Sarapan Chocolate Puff	467	593	23.8	16	15.3	4.47	73.4	68.4	7.05	7.4	8.9	18.4
71	ORI Sarapan Lemon Puff	472	479	1.47	16.2	19.1	16.4	74.2	67.1	10.0	7.4	7.8	5.26
72	Gardenia Delicia Bun Sambal Bilis	317	308.88	2.59	11.7	10.2	13.7	42.2	42.07	0.309	9.5	12.2	24.9
73	Nescafe Milk Coffee Drink	70	71.07	1.52	1.6	1.59	0.627	13.1	12.68	3.26	0.9	1.51	50.6
74	Kellogg's Chocolate Crunch	123	387.04	104	1.5	3.6	82.4	24.3	75.46	103	2.9	13.2	128

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
75	Lady's Choice Mentega Kacang Lapisan Coklat Susu	603	534.6	12.0	43.8	29.6	38.7	37.5	44.15	16.3	15.6	22.9	37.9
76	Yeo's Seri Kaya Original	273	281.39	3.03	3.3	3.63	9.52	58.5	59.02	0.884	2.5	3.16	23.3
77	Nona Kaya Coconut Jam	253	265.08	4.66	2.4	2.32	3.39	56.1	57.99	3.31	1.8	3.06	51.9
78	Moonlight Peanut Butter Creamy	636	570.62	10.8	40	37.5	6.45	21	28.78	31.3	24.7	29.5	17.7
79	Sunstar Pineapple Jam	282	288.24	2.19	0	0	0	70	71.32	1.87	0.4	0.74	59.6
80	Kellogg's Special K Red Berry Cereal Bar	388	401.51	3.42	5.2	5.19	0.192	80	83.56	4.35	4.9	5.14	4.78
81	Drinme Orange Fruit Drink with Jelly	90	45.56	65.6	0	0	0	21	11.39	59.3	0	0	0
82	Tamek 100% Apple Juice 100% Apfelsaft	44	41.2	6.57	0	0	0	11	10.3	6.57	0	0	0
83	Nutrico Lychee in Heavy Syrup	130	63.68	68.5	0	0	0	33	14.88	75.7	0	1.04	200
84	Ayam Brand Fruit Cocktail Firm & Crunchy	81	53.84	40.3	0.1	0	200	18.7	12.49	39.8	0.4	0.97	83.2
85	High 5 Double Crème Espresson & Krim	351	324.1	7.97	14.4	13.5	6.45	48.9	42.05	15.1	5.8	8.6	38.9

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
86	Promex Chocomalt Malted Chocolate Drink	369	431.9	15.7	13.5	11.3	17.7	74	74	0	7	8.55	19.9
87	HomeSoy Instant Soya Milk	421	416.62	1.05	11.1	6.94	46.1	60.5	65.27	7.59	18.4	23.27	23.4
88	Nescafe Blend & Brew (Rich)	439	429.73	2.13	10.5	9.21	13.1	82	81.23	0.943	4.1	5.48	28.8
89	Marigold HL low Fat Chocolate Flavoured Milk	75	76.89	2.49	1	1.93	63.5	11.2	9.34	18.1	5.2	5.54	6.33
90	Superior Ipoh Original White Coffee	449	454.32	1.18	14.3	15.2	6.10	75.2	75.03	0.226	4.8	4.35	9.84
91	Heinz Strawberry Jam	275	285.08	3.60	0.1	0	200	66.5	70.61	5.99	0.25	0.66	90.1
92	Homax Coconut Spread	281	337.76	18.3	3.4	4.2	21.1	60	72.05	18.3	2.5	2.94	16.2
93	Gardenia Delicia Hazelnut Chocolate Spread	546	541.1	0.901	33.5	30.7	8.72	54.5	56	2.71	6.5	10.2	44.3
94	Raya Sri Pandan Kaya	288	300.66	4.30	1	4.58	128	64	61.38	4.18	4	3.48	13.9
95	S&W Mandarin Oranges Selected Sections in Light Syrup	48	80.36	50.4	0	0	0	15.1	19.07	23.2	0	1.02	200
96	Ayam Brand Snacky Nanas	75	74.8	0.267	0	0	0	18	18.09	0.499	0.2	0.61	101

Table App B: Continue

No	Samples	Energy			Fat			Carbohydrate			Protein		
		Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)	Labeling	Analytical	RPD(%)
97	Marigold Peel-Fresh Mixed Blackcurrant Cranberry Juice Drink	51	41.24	21.2	0	0	0	12.7	9.77	26.1	0	0.54	200
98	Marigold Krimier Manis	338	349.14	3.24	10	8.9	11.6	60	64.63	7.43	2	2.63	27.2
99	Dairy Champ Evaporated Creamer	117	124.34	6.08	6.3	5.98	5.21	12	13.82	14.1	3	3.81	23.8
100	Nescafe Ipoh White Coffee	56	59.19	5.54	1.1	1.15	4.44	10	10.3	2.96	1.4	1.91	30.8

Appendix C: Research Paper Published on British Food Journal

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Accuracy of nutrition labels of pre-packaged foods in Malaysia

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Abstract

Purpose – The purpose of this paper is to investigate whether the prepackaged foods in Malaysia are able to provide credible nutrition labels for consumers and how many prepackaged foods do not comply with the tolerance limits, regardless of whether the products are sold in Malaysia or exported to overseas even though there are no standardization of tolerance limits.

Design/methodology/approach – The present study consists of 300 samples (triplicate samples for each product) of core nutrients (energy, fat, carbohydrate and protein), which have been stratified into eight categories, were analysed and the analytical values were compared with the declared values. Compliance of products were obtained through the comparison with different guidelines.

Findings – About 34 per cent of analysed products did not comply with the tolerance limit according to the Food Act 1983, Malaysia (one way approach tolerance limit). Then, 73 per cent of products failed to comply with the tolerance leeway ±20 per cent (two-way approach) and 56 per cent of products did not comply with the tolerance limits set in the Local Authorities Coordinators of Regulatory Services.

Research limitations/implications – Many researches have proved that consumers used nutrition label as a tool to improve their healthy lifestyles. The misleading of nutrition label will elicit detrimental effect to consumers especially who always rely on the nutrition label before purchasing. Hence, credibility of nutrition label is imperative. However, this research only focussed on four major core nutrients. Nutrients such as trans-fat and sodium have proved that are detrimental to human's health are not covered in the study.

Practical implications – First, this research could directly reflect the credibility of nutrition label in the market. The government of the country should improve the surveillance activity on nutrition label. Meantime, free trade activities especially on food industries are active now, an accurate nutrition label is the first key to success in the business. This research can inject awareness to food producers who incline to do global free trade business shall always assure the accuracy of the nutrition label no matter the tolerance or guidelines are different among the countries.

Originality/value – There are many research about improvement in consumers' awareness towards nutrition label but very little research conducted on the accuracy of nutrition label. The main purpose of those research is to improve public health awareness but this may become insignificant if the values of nutrition label are inaccurate. Then, the asymmetric of tolerance limits would trigger awareness from policy makers or food manufacturers to be more responsible in providing credible nutrition label. At the end, consumers are protected from inaccurate nutrition labels and a healthy nation can be sustained.

Keywords Malaysia, Compliance, Accuracy, Nutrition label, Tolerance limits

Paper type Research paper

Introduction

A nutrition label is a panel found on food packaging which contains a variety of information on the nutrition value of the food item. There are many pieces of information which are standard on most food labels, including serving size, number of calories, grams of fat, including nutrient and list of ingredients. This information helps people who are trying to restrict their intake of fat, sugar, sodium and other ingredients, or for those individuals who are trying to optimize their intake of healthy nutrients such as calcium or vitamin C. The label provides each item with its approximate percentage of daily value, generally based on 2,000 of calories. Therefore, nutrition label is acting as a conduit to convey information related to the content of prepackaged food from food manufacturers to consumers.

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Figure App. C: Research paper published on British Food Journal

The paper with title "Accuracy of Nutrition Labels of Prepackaged Foods in Malaysia" has published on British Food Journal, volume 119, issue 2, page 230.

Appendix D: Abstract Published and Paper Presented

3rd International Conference on Food, Ecological and Life Sciences (FELS-2016) May 9-10, 2016 Kuala Lumpur (Malaysia)

Compliance of Nutrition Labels by Comparing the Different Tolerance Limits Approach A Study of Prepackaged Foods in Malaysia

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Abstract: *Nutrition information on food labels acts as a bridge for food producers to convey related information to consumers. Food producers are responsible to provide credible nutrition labels for consumers so that they are able to make a healthier choice based on the nutrition labels to alleviate the non-communicable diseases. The objectives of this study are to investigate whether the prepackaged foods in Malaysia are able to provide credible nutrition labels for consumers and how many prepackaged foods do not comply with the tolerance limits, regardless of whether the products are sold in Malaysia or exported to overseas even though there is no standardization of tolerance limits. The present study consists of 100 samples of core nutrients which have been stratified into 8 categories, are analyzed and the analytical values are compared with the declared values. 34% of analyzed products do not comply with the tolerance limit according to Food Act 1983, Malaysia (one way approach tolerance limit). 73% of products failed to comply with the tolerance leeway ± 20% (two way approach) and 56% of products do not comply with the tolerance limits set in Local Authorities Coordinators of Regulatory Services of Europe. Food producers should be more responsible towards the nutrition labels to avert the products from being rejected by the imported countries. They may need to get analytical services from accredited laboratories to obtain non-misleading nutritional values for the products and consumers can then make healthier choices from the non-deceptive nutrition labels.*

Keywords: *Nutrition Labels, Tolerance Limits, Compliance, Malaysia*

Figure App. D: Abstract published in Emirates Research Publishing

Paper with title "Compliance of Nutrition Labels by Comparing the Different Tolerance Limits Approach, A Study of Prepackaged Foods in Malaysia" has been presented at the 3rd International Conference of Food, Ecological and Life Science (FELS-2016) which was held at 9th and 10th of May, 2016, in Kuala Lumpur. The abstract of the paper was published in the Emirates Research Publishing (ISBN 978-93-84468-53-8), page 29.