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The Nutritional Composition of Mayonnaise and Salad Dressing in the Malaysian Market

(Komposisi Pemakanan Mayonis dan Kuah Salad dalam Pasaran Malaysia)

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ABSTRACT

Mayonnaise and salad dressing are fast becoming popular condiments for Malaysian. The aim of this study was to obtain the nutritional composition of mayonnaise and salad dressing commercially available in the Malaysian market. The data will be used to update the Malaysian Food Composition Database which was last updated in 1997. A total of six brands from each type of mayonnaise and salad dressing were sampled from local supermarkets in the Klang Valley and analysed using standard methods. The validity of test data was monitored with the application of internal quality controls in line with the requirements of ISO 17025. The energy contents of mayonnaise and salad dressings were up to 626.40 kcal/100 g. Our findings were also in agreement with the energy labelling on the packaging. Sodium was high in mayonnaise and salad dressing because it is used in the final mixture of both condiments to improve their characteristics for certain reasons. Mayonnaise and salad dressing have been identified as potent sources of vitamin A and vitamin E and both condiments were found to contain high levels of these antioxidants. It can be concluded that this study are useful not only in providing information on the nutritional content of several commercial types of mayonnaise and salad dressing, but also in improving the public understanding of healthy food choices.

Keywords: Condiments; mayonnaise; nutritional composition; salad dressing

ABSTRAK

Mayonis dan kuah salad berkembang dengan pantas menjadi perencah popular bagi masyarakat Malaysia. Kajian ini bertujuan untuk mendapatkan komposisi pemakanan untuk mayonis dan kuah salad yang berada dalam pasaran di Malaysia. Data yang diperoleh akan digunakan untuk mengemaskini Pangkalan Data Komposisi Makanan Malaysia yang terakhir dikemaskini pada tahun 1997. Sejumlah enam jenama daripada setiap jenis mayonis dan kuah salad telah dibuat pensampelan dari pasaraya tempatan di Lembah Klang dan dianalisis menggunakan kaedah piawaian. Validiti bagi data uji kaji dipantau dengan menggunakan aplikasi kawalan kualiti dalaman selaras dengan keperluan ISO 17025. Kandungan tenaga dalam mayonis dan kuah salad adalah 626.40 kcal/100 g. Keputusan kajian ini selari dengan pelabelan tenaga pada pembungkus. Kandungan natrium adalah dalam mayonis dan kuah salad kerana digunakan dalam campuran akhir kedua-dua perencah tersebut untuk meningkatkan ciri mereka atas alasan tertentu. Mayonis dan kuah salad dikenal pasti sebagai sumber yang kaya dengan vitamin A dan vitamin E dan kedua-dua perencah ini didapati mengandungi kandungan antioksida ini pada kadar yang tinggi. Kesimpulannya, kajian ini amat berguna bukan sahaja dalam menyediakan maklumat tentang kandungan nutrien dalam beberapa jenis mayonis dan kuah salad komersial, tetapi juga dapat meningkatkan pemahaman orang awam tentang pemilihan makanan yang sihat.

Kata kunci: Komposisi pemakanan; kuah salad; mayonis; perencah

INTRODUCTION

Globalization and development have brought in their wake dietary changes among Malaysians. Food and eating habits as the basic need for human survival are also being affected likewise. Increasing demand for food is not only parallel with the increasing urban population but also involves the changing eating behaviour and urban landscape. Changes in consumer eating habits, seen in the patterns of eating-out and eating at hawker stalls, are fast becoming the hallmark of an urban lifestyle. In recent decades, profound changes have occurred in the nutritional perception of foods eaten, not only in Malaysia, but all over the world as well. With marked improvements and sophistication in food technology, there are many examples of convenience foods that have developed in recent years.

Several food condiments that have been accepted as part of a culture for a new Malaysian generation are mayonnaise and salad dressings. Mayonnaise was first invented in France by Duke de Richelieu's chief in 1756. In 1905, the first ready-made mayonnaise was sold at Richard Hellman's New York deli. Mayonnaise is a thick, creamy sauce or dressing that is made of oil, egg yolks,

lemon juice or vinegar and seasonings. There are several ways to prepare mayonnaise, but on average mayonnaise contains approximately 700 kcal (2900 kJ)/100 g of product (USDA 2014). This makes mayonnaise a calorically dense food.

Salad dressing contains less egg yolks and is generally sweeter than mayonnaise. Salad dressing includes condiments such as cream, sauces, cheese and nuts to enhance their taste. Mayonnaise and salad dressing enhance the taste of food and form the highest consumed category of food dressing worldwide (AAFC 2013). These products are often used as a condiment in salads, sandwiches and burgers. Salad and mayonnaise market is segmented as liquid salad dressing, creamy salad topping, low calorie salad dressing and potato salad topping among others.

In recent years, the food manufacturing industry has become increasingly competitive. Consumers have a wide variety of options to choose from and their eating habits have become more experimental. Choice and price competition mean manufactures cannot rely on consumer loyalty alone. Health and obesity issues have led to increase demand for healthy food products such as salads and are expected to positively impact the formulation of mayonnaise and salad dressing in the market. Hence, the aim of this study was to obtain the nutritional composition of mayonnaise and salad dressing commercially available in the Malaysian market and to update the Malaysian Food Composition Database.

Materials and Methods

Sample collection and preparation

Six different commercially available mayonnaise brands and salad dressing brands were selected and sampled from local supermarkets in the Klang Valley. The product sampling criteria were based on the data provided in the Protocol for Sampling and Methods of Analysis for Malaysian Food Composition Database (2011) which required one kilogram of sample for each brand. The samples were stirred in the mixing bowl until thoroughly blended, transferred into air tight containers and kept in the refrigerator at 4°C until further analysis.

Proximate analysis

The moisture content was determined using the drying method. Ten grams (10 g) of each sample was dried for 5-8 h in air-oven at 105°C until constant weight was obtained. The amount of moisture in foods was the difference between the weight before and after drying (AOAC 2008). The kjeldahl method described by AOAC (2005) was used to determine protein content in the samples. One gram of each sample was mixed with 15 mL of concentrated H_2SO_4 (36 N) in a heating tube at 420°C for 1.5 h using a block digestor (Gerhardt, Germany). The digested solution was cooled at room temperature and then transferred into a 100 mL volumetric flask and made up with distilled water, followed by the addition of 80 mL 40% NaOH solution. The mixture was then distilled and the ammonia liberated was collected in a 400 mL beaker containing 50 mL 2% boric acid and a few drops of screened methyl red indicator solution. This distillate was then titrated against 0.1 N H_2SO_4 and calculated for total nitrogen. The nitrogen content was calculated and multiplied with 6.25 to obtain the crude protein content.

Fat content was determined by the semi continuous solvent extraction method (AOAC 2006). A homogenised sample (1-3 g) was weighed into a hydrolysing capsule for hydrolysis using an automatic hydrolysing unit (Gerhardt, Germany). The hydrolysed sample was then transferred into an extraction thimble. Cotton was placed as a lid and the fat extracted with petroleum ether at 40-60ºC using an automated fat extraction system (Gerhardt, Germany) for 2-3 h. The petroleum ether collected was dried at 105ºC for 3 h, then cooled in a desiccator for 1 h and weighed for the fat content. Available carbohydrate content was calculated by subtracting the sum of protein, fat, moisture, ash and total dietary fibre from 100% (Menezes et al. 2004).

Total dietary fibre (TDF) was determined using the enzymatic-gravimetric method (AOAC 2005). Duplicate samples of homogenised foods (1 g) with fat extracted if containing >10% fat, undergo sequential enzymatic digestion by heat stable ∝-amylase, protease and amyloglycosidase to remove starch and protein. For TDF, the enzyme digestate was treated with alcohol to precipitate soluble dietary fibre (SDF) and the TDF residue was filtered, washed with alcohol and acetone, dried and weighed. The TDF values were corrected for protein, ash and reagent blank (TDF = weight of residue – weight (protein + ash).

Ash content was determined using the dry ashing method (AOAC 2005). A clean silica crucible was placed into a muffle furnace at 550ºC over 5 h. The silica crucible was cooled for 1 h in a desiccator and weighed at constant weight. Homogenised sample (3-5 g) was then weighed into the constant weight crucible. The sample was pre-ashed by heating the crucible on a hot plate that was subsequently placed in the muffle furnace at 550ºC for 6-8 h to complete the ashing process. The crucible was then cooled for 1 h and weighed for ash content.

Minerals content

Mineral content such as calcium (Ca), sodium (Na), magnesium (Mg), iron (Fe), zinc (Zn) and copper (Cu) were performed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) (Perkin Elmer, USA). Approximately, 3 g of homogenised samples were digested using dry ashing method (AOAC 2005). The resulting ash was dissolved in 7 mL concentrated hydrochloric acid and then diluted to 100 mL with deionized water. The solution was filtered and the mineral content determined using ICP-OES against the standard solution.

VITAMINS ANALYSIS

The analysis for the 5 types of vitamin B was carried out simultaneously using High Performance Liquid Chromatography (HPLC) with Diode Array and Fluorescence Detector. Six grams of sample was weighed into a 100 mL flask. The sample was dissolved in 30 mL warm water followed by the addition of 0.6 M trichloroacetic acid (TCA). The flask containing the mixture was shaken on a mechanical shaker for 15 min. The resulting mixture was filtered into an HPLC vial and vitamin B_1, B_3 and B_9 content determined by the Diode Array Detector against a standard solution, while the contents for vitamin B_2 and B_6 were determined by Fluorescence Detector against the standard solution.

The analysis for vitamin C was carried out using HPLC with Diode Array Detector. The method involved dissolution of sample in Tris (2-carboxyethyl)-phosphine hydrochloride acid and simple removal of protein using trichloroacetic acid (TCA) followed by reversed phase LC (Brause et al. 2003).

The analysis for fat soluble vitamins A and E was carried out simultaneously using HPLC with Diode Array and Fluorescence Detector. This method involved the saponification of standards and samples in basic ethanol-water solution, extraction of the analyte from the neutralised mixture and followed by reversed phase LC (De Vries & Silvera 2002). A 5 g sample was weighed into a 250 mL flask followed by the addition of a pea-sized pyrogallol acid as an antioxidant and 40 mL of 95% ethanol. This solution was then saponified with 10 mL of 50% potassium hydroxide (KOH) under controlled conditions. Ten milliliter of glacial acetic acid was then added to neutralise the KOH and the vitamin A and vitamin E extracted into a mixture of tetrahydrofuran (THF) and ethanol (1:1) solution. The extractant was filtered into an HPLC vial and the vitamin A content was determined by Diode Array Detector against the standard solution, while vitamin E content was determined by Fluorescence Detector against the standard solution.

TOTAL SUGAR CONTENT

The analysis of total sugars, sucrose, glucose, fructose, lactose and maltose was done using HPLC with Evaporative Light Scattering Detector (ELSD). Sample (4 g) was weighed into a 100 mL volumetric flask. The sample was dissolved into approximately 25 mL of water before further dilution to 100 mL. The sample was filtered using a 0.45 μm membrane filter before injected into HPLC.

FATTY ACID PROFILE

Fatty acids in samples were determined by converting the triglycerides and phospholipids in the samples into fatty acids methyl esters (FAME) by saponification and esterification in the presence of boron trifluoride with triglyceride triundecanoin C11:0 added as the internal standard (AOAC 2005). The resulting fatty acid methyl esters were then analysed using Agilent Technologies 7890A Gas Chromatograph with a Flame Ionisation Detector, equipped with a capillary column DB-WAX (30 m × 0.250 mm, film thickness 0.25 μm) and helium as the carrier gas.

CHOLESTEROL ANALYSIS

Lipid in the test portion of a sample was saponified with ethanolic KOH solution. The unsaponified fraction containing cholesterol and other sterols was extracted with toluene and derivatised with hexamethyldisilane (HMDS) and trimethylchlorosilane (TMCS) to its trimethylsilyl (TMS) ethers which were then quantified by gas chromatography (AOAC 2008). A 5 g sample was weighed into a 250 mL flask followed by the addition of 40 mL of 95% ethanol. This solution was then saponified with 8 mL of 50% KOH under controlled condition. Once completed, the mixture was extracted with toluene to remove the unsaponified fraction containing cholesterol and other sterols. The residue was then dissolved in dimethylformamide (DMF) solution and derivatized with HMDS and TMS and subsequently analysed for sterols using 5 alpha cholestane as the internal standard.

STATISTICAL ANALYSIS

SPSS (V 18.0) was used for the statistical analyses of this study. The mean difference among groups was compared using Kruskal-Wallis. Significance was accepted at probability $p<0.05$. All results were reported as mean and range.

RESULTS AND DISCUSSION

GENERAL

Mayonnaise is essentially an oil-in-water emulsion in which the oil phase represents 60-80% of the total. The emulsifying agents used in mayonnaise are those which have been known from hundreds of years: egg yolk and mustard. The related emulsion i.e. salad dressing is relatively simple to prepare in contrast to mayonnaise. The emulsion of salad dressing is largely stabilized by egg yolk. The oil concentration in salad dressing is much lower than mayonnaise which has a standard identity of not less than 65% oil (FDA 2010).

PROXIMATE COMPOSITION

Mayonnaise is a high calorie food that is stabilized by egg yolks (Mine 1998). Depending on the formulation used, a system where the oil droplets are dispersed in the aqueous phase is called oil-in-water emulsion (O/W). Food systems like O/W are mayonnaise, milk, cream, soups and sauces. The opposite of an O/W emulsion is water-in-oil (W/O) but there are also water free emulsions and multiple emulsions (O/W/O or W/O/W).

In this study, the energy contents of mayonnaise and salad dressings were up to 626.40 kcal/100 g (Table 1). Based on this, the mayonnaise and salad dressing are calculated to contain approximately 6.26 kcal/g with up to 62.18 g of mostly fat, 67.55 g of carbohydrate, 1.26 g of protein in 100 g while being rich in vitamins and minerals. In comparison to USDA (2014) data which reported that mayonnaise to contain approximately 700 kcal (2900 kJ)/100 g of energy content, our study recorded much lesser amount of energy content in mayonnaise. Our findings were also in agreement with the energy labelling on the packaging. Based on the labelling, the energy content of these products in the market provided a wide range in between 270-648 kcal/100 g.

It has been reported that protein-calories malnutrition deficiency is a major factor responsible for nutritional pathology (Roger et al. 2005). There was no significant difference in protein contents between mayonnaise and salad dressing (Table 1). Both mayonnaise and salad dressing were found to contain protein in the range of 0.63-1.26 and 1.02-1.11 g/100 g, respectively. Although egg yolks and whites are sources of dietary protein, the nutritional value (including the amount of protein) differs between the yolks and whites of eggs. Egg yolks minimally consist of 56% fat (lipids) and 30% protein. It is an emulsifier that also acts as a coloring agent to the finished mayonnaise product. Furthermore, egg yolk is critical for the stability of the mayonnaise and salad dressing (Hasenhuettl 2008) contains slightly less protein than white eggs (USDA 2012) which is probably the reason why low protein contents were found in mayonnaise and salad dressing. The results of this work showed inadequate amount of protein present in these products.

The ash content, which is an index of mineral contents in biota, was significantly higher in salad dressing than in mayonnaise. This indicates both food condiments could be good sources of mineral elements (Table 1).

MINERAL COMPOSITION

High calcium content was found in salad dressing although there was no significant difference ($p>0.05$) between mayonnaise and salad dressing (Table 2). A high calcium intake is achieved by increasing servings of milk and dairy products and other foods containing appreciable amounts of calcium. Taking 8 tablespoons (1 tablespoon equal to 13 mg) of mayonnaise or salad dressing contains up to 848 mg of sodium, which is 28% of the U.S. recommended sodium allowance of 2400 mg per day. Sodium is high because it is used as a preserving agent. Sodium can be added to the final mixture to improve the characteristics of mayonnaise for three reasons. First, the sodium particles help to disperse the egg yolk granules to make more surface-active material available. Second, the added sodium will neutralize any charges that are found on the proteins. This will allow the proteins to adsorb and strengthen the existing layer on the oil droplets. Third, the neutralization of any charge allows the oil droplets adjacent to each other to interact more strongly (Depree & Savage 2001). Other type of minerals analysed in the study were iron, zinc, copper and magnesium. However, there was no significant difference ($p>0.05$) on the concentration level of iron, zinc, copper and magnesium between mayonnaise and salad dressing samples.

TABLE 1. Proximate composition of mayonnaise and salad dressing

Nutrient	Mayonnaise Mean ± SEM (Range) g/100g	Salad Dressing Mean ± SEM (Range) g/100g	p-value
Energy (Kcal)	432.73 ± 61.76 (270.99-626.40)	366.02 ± 42.25 (256.06- 540.13)	0.394
Water	28.71 ± 6.96 (16.63- 59.93)	44.07 ± 4.59 (31.06- 59.79)	0.095
Protein	1.09 ± 0.1 (0.63-1.26)	1.06 ± 0.16 (1.02-1.11)	0.829
Fat	30.76 ± 9.12 (5.69-62.18)	29.85 ± 5.38 (13.72- 53.47)	0.933
Carbohydrate	37.88 ± 9.06 (13.72- 67.55)	22.71 ± 3.74 (12.36- 33.43)	0.153
TDF	0.00 ± 0.00	1.15 ± 0.55 (0-3.1)	0.062
Ash	1.57 ± 0.13 (1.2-2.0)	2.32 ± 0.24 (1.6-3.2)	*0.021

*$p<0.05$ are significant differences for Kruskal-Wallis test between various types of salad dressing and mayonnaise. The results are expressed in mean and range

TABLE 2. Mineral content of mayonnaise and salad dressing

Nutrient	Mayonnaise Mean ± SEM (Range) mg/100g	Salad Dressing Mean ± SEM (Range) mg/100g	p-value
Calcium	9.2 ± 1.39 (6-16)	19 ± 3.58 (7-30)	0.052
Iron	0.06 ± 0.06 (0-0.3)	0.42 ± 0.18 (0.1-1.1)	0.073
Magnesium	1.3 ± 0.03 (0.1-1.8)	4.25 ± 1.39 (0.8-9.7)	0.064
Sodium	603.6 ± 54.38 (444-780)	848.67 ± 96.92 (575-1240)	*0.034
Zinc	0.29 ± 0.08 (0.11-0.53)	0.19 ± 0.03 (0.2-0.34)	0.238
Copper	ND	0.013 ± 0 (0.01-0.02)	0

*p<0.05 are significant differences for Kruskal-Wallis test between various types of salad dressing and mayonnaise. The results are expressed in mean and range

VITAMIN COMPOSITION

Vitamins are organic compounds that are essential in small amounts of the diet to promote and regulate body functions necessary for growth, reproduction and the maintenance of health (Smolin & Grosvenor 2007). Mayonnaise and salad dressing have been identified as potent sources of vitamin A and vitamin E. This comes as no surprise as eggs and edible oils from plant sources, the two main ingredients, are both rich in these condiments. A study conducted on post-menopausal women showed that these antioxidant condiments were able to decrease the risk of succumbing to stroke (Yochum et al. 2000).

Vitamin C was not detected in mayonnaise and salad dressing (Table 3). Vitamin C was also not detected in other studies done overseas (Swiss Food Composition Databases 2012; USDA 2012). All four B vitamins were

TABLE 3. Vitamins content of mayonnaise and salad dressing

Nutrient	Mayonnaise Mean ± SEM (Range) mg/100g	Salad Dressing Mean ± SEM (Range) mg/100g	p-value
Vitamin C	ND	ND	0
Thiamin (B1)	0.03 ± 0.03 (0.05-1.91)	0.05 ± 0.22 (0.05-1.91)	0.484
Riboflavin (B2)	0.15 ± 0.03 (0.11-0.16)	0.15 ± 0.03 (0.11-0.19)	0.598
Niacin (B3) as nicotinic acid	0.08 ± 0.08 (0-0.48)	0.33 ± 0.57 (0-0.33)	0.802
Niacin (B3) as Nicotinamide	0.64 ± 0.40 (0.6-2.44)	2.6 ± 1.61 (1.37-5.39)	*0.02
Pyridoxine (B6)	0.03 ± 0.16 (0.02-0.03)	0.03 ± 0.18 (0.03-0.04)	0.049
Folic Acid (B9) (µg/100g)	1.08 ± 0.68 (3.1-3.35)	4.78 ± 0.88 (3.10-8.55)	*0.007
Vitamin A (µg/100g)	4.17 ± 4.17 (0-25)	32.92 ± 24.33 (50-147.5)	0.271
Vitamin E	5.44 ± 2.33 (1.81-10.15)	5.31 ± 2.30 (2.57-10.84)	0.943

*p<0.05 are significant differences for Kruskal-Wallis test between various types of salad dressing and mayonnaise. The results are expressed in mean and range

not significant in mayonnaise and salad dressing except for niacin as nicotinamide (B_3) and folic acid (B_9) which were found to be higher ($p<0.05$) in salad dressing. Niacin (as nicotinamide) mean levels in mayonnaise and salad dressing analysed range from 0.6 to 2.44 mg/100 g and 1.37 to 5.39 mg/100 g, respectively (Table 3). Folic acid mean levels in mayonnaise and salad dressing analysed range from 3.1 to 3.35 µg/100 g and 3.10 to 8.55 µg/100 g, respectively. Niacin is important in helping the normal function of various sex and stress-related hormones in the adrenal glands and other parts of the body. Whereas, folic acid (also known as Vitamin B_9) is required in the production of DNA and in numerous other bodily functions (Greenberg et al. 2011).

SUGAR CONTENT

Table 4 shows the sugar contents in mayonnaise and salad dressing. It was found that the total sugar was significantly higher in salad dressing (15.47 g/100 g) compared to mayonnaise (8.59 g/100 g). Among all the sugars analysed, glucose was found significantly higher in salad dressing (4.28 g/100 g) compared to mayonnaise (1.71 g/100 g). It came as no surprise because one of the studies on salad dressing found that a one-cup serving of reduced-calorie French dressing heaps 58 g of added sugar and a one-cup serving of reduced-fat coleslaw dressing heaps 103 g of added sugar. Lactose was not detected in all tested brands of mayonnaise and salad dressing. Hence, people with lactose-intolerance may tolerate certain types of mayonnaise and salad dressing. Although fructose was found to be higher in salad dressing compared to mayonnaise, no significant difference was recorded. On the other hand, maltose was found in some types of mayonnaise and not in salad dressing in the range of 0 to 0.18 g/100 g.

FATTY ACID COMPOSITION

Avian eggs contain a high proportion of lipid when compared to eggs from amphibian and invertebrates. Most of these lipids are particles of low-density lipoproteins that are derived from the very-low-density lipoprotein (VLDL) of blood (Evans & Burley 1987).

The consumption of saturated fatty acids (SFA), trans-fatty acids, cholesterol and oxysterol increases degenerative arterial process. On the contrary, unsaturated fatty acids (UFA) are an equilibrium factor to the fatty acid metabolism (Valenzuela et al. 1998; Valenzuela 1997).

The Nutrition Committee of the American Heart Association had published recommendations on fat and cholesterol consumption: 25-30% of fat; 10% SFA, 10% polyunsaturated fatty acid (PUFA), 10-15% monounsaturated fatty acids (MUFA) of the total calories and cholesterol less than 300 mg/day (Johnston et al. 2000). Table 5 shows that the MUFA was significantly higher in salad dressing compared to mayonnaise. The amount of MUFA in salad dressing and mayonnaise was 18.7 and 7.84 g/100 g, respectively. The most common form of dietary MUFAs is oleic acid (C18:1 n-9), which occurs in the cis form. It was found that MUFA-rich diets lower apolipoprotein β concentrations along with decline in LDL cholesterol level (Allman-Farinelli et al. 2005; Rajaram et al. 2001). Consumption of MUFA-rich diets also induces lower triglycerides and higher HDL cholesterol concentrations compared to low-fat, high-carbohydrate diets (Jiménez-Gómez et al. 2010). Long term MUFA-rich diets result in an earlier postprandial peak in plasma triglyceride and apo β-48 concentrations (Roche et al. 1998) although this mechanism is not clear. Oleic acid has been shown to be preferentially esterified into triglycerides in the enterocyte (Dashti et al. 1990) which may result in faster entry rate of chylomicrons into the circulation,

TABLE 4. Sugar composition of mayonnaise and salad dressing

Nutrient	Mayonnaise Mean ± SEM (Range) g/100 g	Salad dressing Mean ± SEM (Range) g/100 g	p-value
Total sugar	8.59 ± 1.20 (3-10.16)	15.47 ± 2.40 (7.3-21.7)	*0.025
Sucrose	5.48 ± 1.23 (5.2-8.6)	5.35 ± 1.55 (2.1-10.9)	0.948
Glucose	1.71 ± 0.31 (0.84-3)	4.28 ± 1.03 (2.6-9.3)	*0.037
Fructose	1.40 ± 0.2 (0.72-2)	5.83 ± 2.31 (2.4-15.6)	0.085
Lactose	ND	ND	ND
Maltose	0.18 ± 0.18 (0- 1.1)	ND	0.341

*$p<0.05$ are significant differences for Kruskal-Wallis test between various types of salad dressing and mayonnaise. The results are expressed in mean and range

TABLE 5. Fatty acids content of mayonnaise and salad dressing

Nutrient	Mayonnaise Mean ± SEM g/100 g	Salad Dressing Mean ± SEM g/100 g	p-value
Total saturated fat	12.49 ± 6.85	7.47 ± 1.73	0.494
C4:0	0 ± 0.00	0 ± 0.00	-
C6:0	0 ± 0.00	0 ± 0.00	-
C8:0	0 ± 0.00	0 ± 0.00	-
C10:0	0 ± 0.00	0.02 ± 0.26	0.341
C12:0	0.05 ± 0.048	0.033 ± 0.03	0.806
(Lauric acid)			
C13:0	0 ± 0.00	0 ± 0.00	-
C14:4	0.19 ± 0.16	0.17 ± 0.11	0.938
(Myristic acid)			
C15:0	0.02 ± 0.02	0.02 ± 0.02	0.883
C16:0	10.02 ± 6.27	4.53 ±2.13	0.408
(Palmitic acid)			
C17:0	0.06 ± 0.03	0.06 ±0.01	0.976
C18:0	1.21 ± 1.10	1.97 ± 0.48	0.27
(Stearic acid)			
C20:0	0.27 ± 0.19	0.23 ± 0.0.06	0.846
C21:0	0.04 ± 0.01	0.04 ± 0.01	0.9
C22:0	0.43 ± 0.23	0.25 ± 005	0.467
C23:0	0.03 ± 0.00	0.03 ±0.01	0.809
C24:0	0.17 ± 0.08	0.12 ± 0.03	0.558
(Lignoceric acid)			
Total monounsaturated fat	7.84 ± 2.8	18.70 ±2.87	*0.021
C14:1	0.01 ± 0.08	0.01 ± 0.09	0.885
C15:1	0 ± 0.00	0 ± 0.00	-
C16:1	0.11 ± 0.08	0.14 ± 0.04	0.731
C17:1	0.04 ± 0.02	0.04 ± 0.00	0.892
C18:1	7.22 ±2.69	16.94 ± 4.12	*0.03
(Oleic acid)			
C20:1	0.34 ± 0.16	1.44 ± 1.20	*0.049
C22:1	0.06 ± 0.04	0.02 ± 0.01	0.413
C24:1	0.06 ± 0.02	0.10 ± 0.03	0.275
Total polyunsaturated fat	10.38 ± 3.22	3.63 ± 1.91	0.256
C18: 2	9.05 ± 3.00	2.03 ± 1.09	0.203
Nutrient	Mayonnaise Mean ± SEM g/100 g	Sauce, Thousand Island Mean ± SEM g/100 g	p-value
C18:3	1.05 ± 1.02	1.06 ± 1.03	0.99
C20:2	0.04 ± 0.02	0.11 ± 0.33	*0.044
C20:3	0.05 ± 0.02	0.21 ± 0.07	0.071
C22:2	0.12 ± 0.12	0.06 ± 0.02	0.648
C20:4	0.03 ± 0.02	0.01 ± 0.00	0.516
C20:5	0.02 ± 0.00	0 ± 0.00	0.063
C22:6	0 ± 0.00	0.14 ± 0.13	0.347
Trans fatty acids	0.05 ± 0.02	0.02 ± 0.00	0.387
Cholesterol (mg/100 g)	25.67 ± 5.07	37.60 ±6.13	0.235

*p<0.05 are significant differences for Kruskal-Wallis test between various types of salad dressing and mayonnaise. Results are expressed in mean and range

reflecting accelerated rates of digestion and absorption or upregulation of chylomicron synthesis and secretion (Silva et al. 2003). The major fatty acids in all samples tested were palmitic acid (C16:0). The palmitic acid content was higher in mayonnaise (10.02 g/100 g) when compared to salad dressing (4.53 g/100 g). The SFA and the PUFA were found to be higher in mayonnaise than salad dressing. However, the MUFA was found to be higher in salad dressing than in mayonnaise. The two essential fatty acids, linoleic acid and alpha-linolenic acid are PUFA. Each of these two essential fatty acids is highly unique and important to health.

Conclusion

In conclusion, this study has shown that mayonnaise and salad dressing available in the Malaysian market are high in energy content. Both condiments are also a good source of minerals, vitamins A and E, as well as linoleic acid and alpha-linolenic acids which are highly unique and of health importance. The findings of this study are useful not only in providing information on the nutritional content of several commercial types of mayonnaise and salad dressing, but also in improving the public understanding of healthy food choices. The data obtained can be updated to the Malaysian Food Composition Database which is used by nutritionists, dieticians and researchers for nutrition related activities.

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