Original Research Article

Quality Analysis for Different Samples of Fats

ABSTRACT

Fat is one of the three main macronutrients, along with carbohydrate and protein, these is an important foodstuff for many forms of life, and metabolic functions. Some fatty acids that are set free by the digestion of fats are called essential because they cannot be synthesized in the body from simpler constituents. This study will determine the physical and chemical properties such as Color, melting point, moisture, acid value, free fatty acid, peroxide value and insoluble impurities for different types of fat on the market in Saudi Arabia. Four samples of fat of different manufactures were selected randomly as goody, hanaa, fork & spoon and Mazola. The percentage of the moisture was found to be 0.167±0.0438, 0.1045±0.0021, 0.061±0.0141 and 0.101±0.0339 %, respectively for goody, hanaa, fork & spoon and mazola. The acid values were found to be 0.1402, 0.148, 0.151 and 0.220 mg NaOH/g for goody, hanaa, fork & spoon, and mazola, respectively. The free fatty acid was found to be 0.0989, 0.105, 0.106 and 0.155 % for goody, hanaa, fork & spoon and mazola, respectively. The peroxide values were found to be 4.25±0.0141, 3.245±0.0353, 1.145±0.1485 and 5.15±0.0707 m.eqO2/Kg for goody, hanaa, fork &spoon, and mazola, respectively. The insoluble impurities was found to be 1.61, 0.71, 1.32 and 1.33 % for goody, hanaa, fork & spoon , and mazola, respectively. The melting points were found to be 40±0, 35±0, 33.5±0.707 and 39±0 °C for goody, hanaa, fork & spoon, and Mazola, respectively.

The percent of moisture, acid value, free fatty acid, peroxide value and melting points for different fat samples were compared with the value in literature reviews and were found to be in ideal range. However, the insoluble impurities were found slightly increase than the range except in hanaa.

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Key words: Fat; peroxide value; melting point; moisture; acid value; impurities.

1. INTRODUCTION

Oils and fats have been used from ancient times for food preparation as well as in non-food applications like lamp oil, lubricant, soap manufacturing and skin care. They are provide functionality in food preparation and use as well as nutritional benefits. They serve as a heat transfer medium at elevated temperatures (e.g. frying), improve taste, give texture and flavor to a wide range of foodstuffs. Its originated from plant and animal sources, the plant based oils and fats dominate in current food applications[1]. However, the supply chains of vegetable oils and fats consist of [1]: (i) the growing of oil seeds, fruits and nuts, (ii) oil extraction, (iii) purification and modification processes to optimize the properties of oils, and (iv) all transport from grower to end user [1].

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Fats are a concentrated form of energy and protect body tissues and organs and help maintain body temperature. Fats also help the body to use the four fat soluble vitamins: A, D, E, and K. Normally, when discussing fats, we are referring to triglycerides, 95% of dietary fats are composed of triglycerides, which are made up of 3 fatty acids. Fatty acids are chains of carbon (C) atoms with hydrogen (H) atoms attached, and with an acid group (COOH) on one end. One example of a fatty acid is linoleic acid, is an unsaturated omega-6 fatty acid and is found in the lipids of cell membranes, and it is abundant in many vegetable oils, including sunflower and corn oils [2].

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Vitamin A is a generic term including two classes of compounds: retinoids found in foods of animal origin and carotenoids present in fruits and vegetables [3].

Vitamin D is represented by two main forms: vitamin D_3 or cholecalciferol (D_3) and vitamin D_2 or ergocalciferol (D_2), All of them are derived from the UV irradiation of provitamin D sterols in the animal skin and plants respectively [4].

Vitamin E collects eight tocochromanols, all of them of plant origin: four tocopherols (Ts) having a saturated isoprenoid side chain and four tocotrienols (T3s) with a side chain analogous to Ts but containing three trans double bonds. Ts and T3s are designated as α-, β-, γ- and δ-according to the number and position of the methyl substituents in the chromanol ring. Difficulties hindering the speciation of the vitamin

E homologues have mainly concerned the chromatographic separation of the positional isomers β- and γ- which have often been determined globally [5,6] .

Vitamin K is represented by two families of compounds with a common naphthoquinone nucleus and a differing side chain : vitamin K_1 or phylloquinone (K_1) having a phytyl chain, from plant foods and vitamin K_2 including the group of menaquinones (MK-*n*, with *n* number of unsaturated isoprene unit varying from 4 to 13) from bacterial sources[7,8].

The major analytical hurdles which so far have hampered the MK-*n* analysis in foods of animal origin (they are absent in plant foods) are: the very low concentrations, the co-extraction of lipids interfering with the menaquinone-4 (MK-4) determination, and the limited availability and/or high cost of their authentic standards [9].

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2. MATERIALS AND METHODS

2.1 Substance:

Different fat samples were purchased commercially from different manufacturers in Saudi Arabia, as shown in Table (1).

Table 1. Types and color of fats.

Name	Expiry date	Manufacture date	Color
Goody	23/11/2017	23/5/2016	Off-white
Hanaa	1/8/2018	2/2/2017	Yellow
Fork& spoon	12/5/2018	12/11/2016	Yellow
Mazola	24/12/2017	25/12/2016	Yellow

2.2 Preparation of solutions:

2.2.1 0.1M NaOH solution

4 g of NaOH was weighed and placed in a 1000 ml volumetric flask. The water was added to a level equal to 1000 ml, and shacked well to dissolve the solid [10].

2.2.2 0.01N $Na_2S_2O_3$ solution

2.5g of sodium thiosulfate was dissolved in water that has been previously boiled and cooled. Diluted to 1 L water, stopper the bottle and mix the solution by continuous shaking[11].

2.2.3 0.01N $K_2Cr_2O_7$ solution

0.49g potassium dichromate was dissolved in 1 L of distilled water [12].

2.2.4 Phenolphthalein indicator (acid/Base indicator)

1g of phenolphthalein was weighed and dissolved in 100 ml of 95% ethanol solution [13] .

2.3 Instruments and working procedures

2.3.1 Determination of the moisture

5g of each fat sample was weighed into crucible and putted in an oven at (105℃ for 3 hour) [14]. The moisture was calculated using the following formula:

$$\%\text{Moisture} = \frac{\text{weight of sample before} - \text{weight of sample after}}{\text{weight of sample}} \times 100$$

2.3.2 Determination of the acidity

5g of each fat sample was weighed into conical flask and dissolved with 50 ml ethanol alcohol, (2-3) drops of phenolphthalein was added and putted the mixture in water bath for 10 min. The mixture was titrated with 0.1M NaOH solution until the end point appears. The acid value and the free fatty acid [15] was calculate using the following formula:

$$\text{AV}(mgNaOH/g) = \frac{\text{V(NaOH)} \times \text{N(NaOH)} \times 40}{\text{Wieght of sample}}$$

V: End point volume of NaOH in ml.

N: Normality of NaOH.

40: Molar mass of NaOH.

However, the free fatty acid of the fat sample was determined by:

$$\%FFA = \frac{N(NaOH) \times Mwt \times 100 \times e.q}{weight\ of\ sample \times 1000}$$

N: Normality of NaOH.

Mwt: Molecular weight as oleic acid.

E.q: Equivalent point of NaOH in ml.

2.3.3 Standardization of NaOH with KHP

Potassium hydrogen phthalate (KHP) can be used as the primary standard, and phenolphthalein as the indicator. 0.2 g of KHP was diluted with 50 ml of water in an Erlenmeyer flask. No more than 2 drops of phenolphthalein was added to the flask to avoid a bias. The KHP solution was then titrated with 0.1 N NaOH until end point was reached . The average normality of NaOH was found to be 0.0976M±0.000751, Table (2).

Table 2. Standardization of NaOH with KHP.

	Trial 1	Trial 2	Trial 3
Mass KHP (g)	0.2455	0.2575	0.2477
Volume of NaOH delivered (ml)	12.5	13.2	12.5
Normality of NaOH	0.0976	0.0969	0.0984
Average Normality	0.0976N±0.000751		

2.3.4 Determination of peroxide number

5g of each fat sample was weighed into glass-stoppered Erlenmeyer flask and dissolved in 30 ml (3:2) acetic acid-chloroform solution, 0.5 ml saturated KI was added. The solution was allowed to stand with occasional shaking for exactly 1 min and 30 ml distilled water was added. Titrated with 0.01N $Na_2S_2O_3$ until yellow color

has disappeared, then about 0.5 ml starch indicator solution was added and continue titration, until end point[16].The peroxide value was calculated using the following formula:

$$PV\ (m.eqO_2/kg) = \frac{V(Na2S2O3)\times N(Na2S2O3)\times 1000}{\text{Wight of the sample}}$$

V: Volume of $Na_2S_2O_3$ in ml.

N: Normality of $Na_2S_2O_3$ in N.

2.3.5 Standardization of $Na_2S_2O_3$ with $K_2Cr_2O_7$

1ml concentrated H_2SO_4 was added to 80 ml of distilled water into Erlenmeyer flask with constant stirring, then 10 ml 0.01N $K_2Cr_2O_7$ and 0.6g of KI was added. The mixture was allowed to stand for 6 minutes in the dark. Titrated with 0.01N $Na_2S_2O_3$ until the iodine color is almost discharged. 1 ml starch indicator was added and completed the titration until blue color disappears[11]. The average normality of $Na_2S_2O_3$ was found to be 0.008983N±0.00008, Table (3).

Table 3. Standardization of $Na_2S_2O_3$ with $K_2Cr_2O_7$.

	Trial 1	Trial 2	Trial 3
Volume $K_2Cr_2O_7$ (ml)	10	10	10
Volume of $Na_2S_2O_3$ (ml)	11.2	11	11.1
Normality of $Na_2S_2O_3$	0.0089	0.0091	0.0090
Average Normality		0.0090N±0.00008	

2.3.6 Detection for the percent of impurities

3-5 g of each fat samples was weighed in conical flask, 50 ml of hot hexane was added to soluble the sample, the solution was filtered. The filter paper was putted

in an oven to dry. The percent of impurity percent in samples[17] was caculated by using the following formula:

$$\%\ \text{impurities} = \frac{\text{weight of paper after} - \text{weight of paper before}}{\text{weight of the sample}} \times 100$$

2.3.7 Detection of melting point

Scrape a capillary tube along a block of fat, attach a thermometer to the capillary tube with an elastic band and using a retort stand, clamp the tube and thermometer in a beaker of cold water. Then, heat the water gently with a Bunsen burner, stirring occasionally. Observe the fat and note the temperature [18]

3. Results and discussion

3.1 Moisture

The moisture for each fat sample was found to be 0.167±0.0438, 0.1045±0.0021, 0.061±0.0141 and 0.101±0.0339, for goody, hanaa, fork& spoon, and mazola, respectively as shown in Fig. (1) and Table (4). The highest moisture percent was found to be in goody fat because it is mixture of soybean oil, hydrogenated palm oil and palm oil, and the lowest percent was found in fork& spoon fat because to it has only pure palm oil. All the percent of moisture for different fat samples within the limited range (less than 0.5%).

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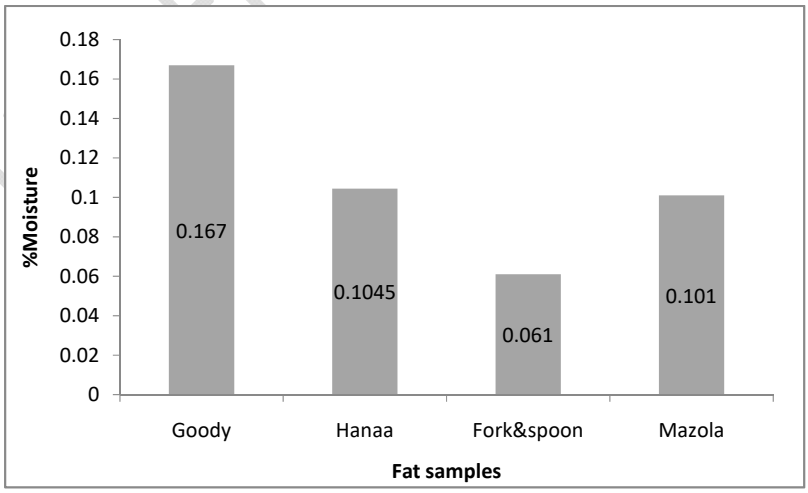

Fig. 1. The moisture for different fat samples.

Table 4. The moisture for different fat samples.

Samples	%Moisture
Goody	0.167±0.0438
Hanaa	0.1045±0.0021
Fork& spoon	0.061±0.0141
Mazola	0.101±0.0339

3.2 Acid value

The acid value is the number of mg of sodium hydroxide required to neutralize the free fatty acid in 1 g of the fat. It was found to be 0.1402, 0.148, 0.151 and 0.220 mg NaOH/g for goody, hanaa, fork& spoon, and mazola, respectively as shown in Fig. (2) and Table (5). The highest acid value was found in mazola fat because it's contain corn oil and sunflower oil, however, the lowest value was found in goody fat because it's mixture of soybean oil, palm oil and hydrogenated palm oil. All the acid values for different fat samples within the limit, which it should be below 0.6 mg NaOH/g.

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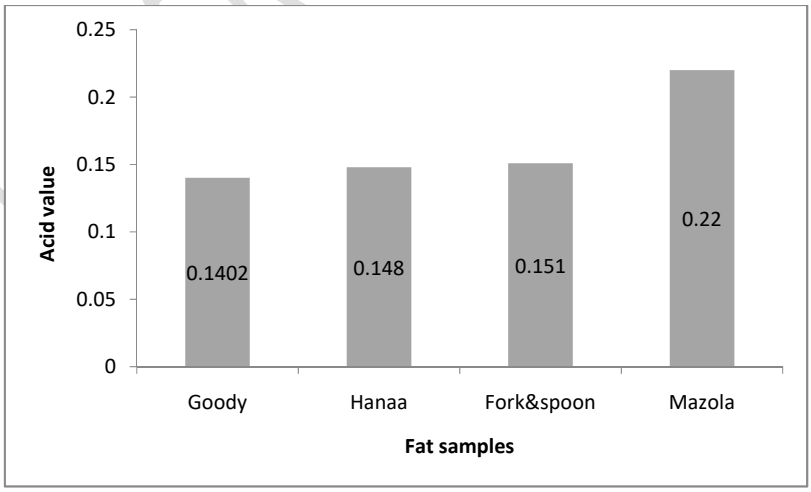

Fig. 2 The acid value for each fat sample.

Table 5. The acid values for each fat sample.

Samples	Acid value (mg NaOH/g)
Goody	0.1402
Hanaa	0.148
Fork& spoon	0.151
Mazola	0.220

3.3 Free fatty acid

The percent of free fatty acid for each fat sample was determined by titration against 0.1M of NaOH. It was found to be 0.0989, 0.105, 0.106 and 0.155 % for goody, hanaa, fork& spoon and mazola, respectively as shown in Fig. (3) and Table (6). The highest FFA% was found in mazola because its mixture of corn oil and sunflower oil, and the lowest percent was found in goody fat because it's mixture of palm oil and hydrogenated palm oil. The percent of free fatty acid (%FFA) for all different fat samples within the limited range (less than 0.5%).

:[8Z]Comment

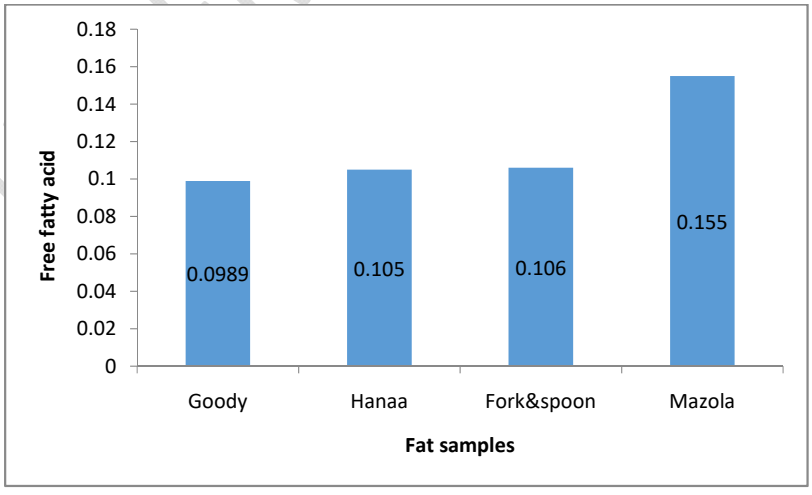

Fig 3. The percent of free fatty acid for each fat sample.

Table 6. The percent free fatty acid for different fat samples.

Samples	%Free fatty acid
Goody	0.0989
Hanaa	0.105
Fork& spoon	0.106
Mazola	0.155

3.4 Peroxide value

The peroxide value is the quantity of those substances in the sample, expressed as milliequivalents of active oxygen per kilogram. It was found to be 4.25±0.0141, 3.245±0.0354, 1.145±0.1485 and 5.15±0.0707 m.eqO_2/Kg for goody, hanaa, fork& spoon, and mazola, respectively as shown in Fig. (4) and Table (7). The highest peroxide value was found in mazola fat because it mixture of pure corn oil, partially hydrogenated palm oil and sunflower oil, and the lowest value was found in fork& spoon fat because it has only pure palm oil. All the peroxide values for different fat samples within the limited range (0 -12).

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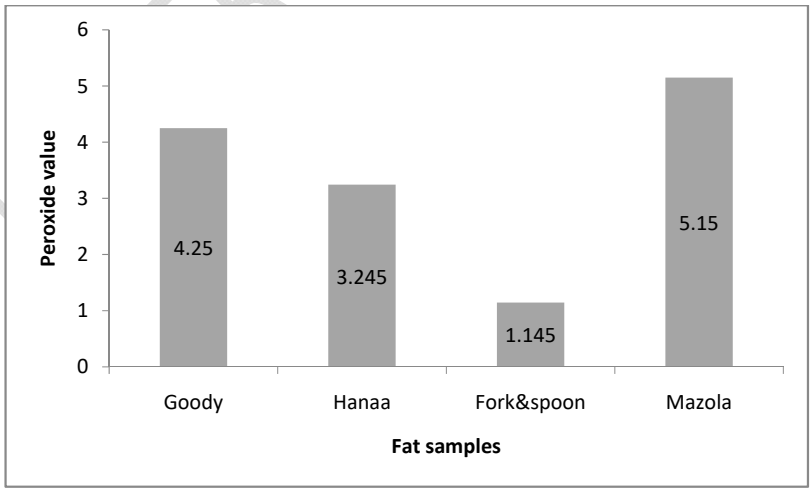

Fig 4. The peroxide value for different fat samples.

Table 7. The peroxide value for each fat sample.

Samples	Peroxide value ($meqO_2/kg$)
Goody	4.25±0.0141
Hanaa	3.245±0.0354
Fork& spoon	1.145±0.1485
Mazola	5.15±0.0707

3.5 Insoluble impurities

The insoluble impurities of the fat sample, which not dissolved in the specified solvent, expressed in percent by mass. It was found to be 1.61, 0.71, 1.33 and 1.32 % for goody, hanaa, fork& spoon, and mazola, respectively as shown in Fig.(5) and Table (8). The insoluble impurities found to be slightly increase than the ideal range (lower than 1%) expect in hanaa.

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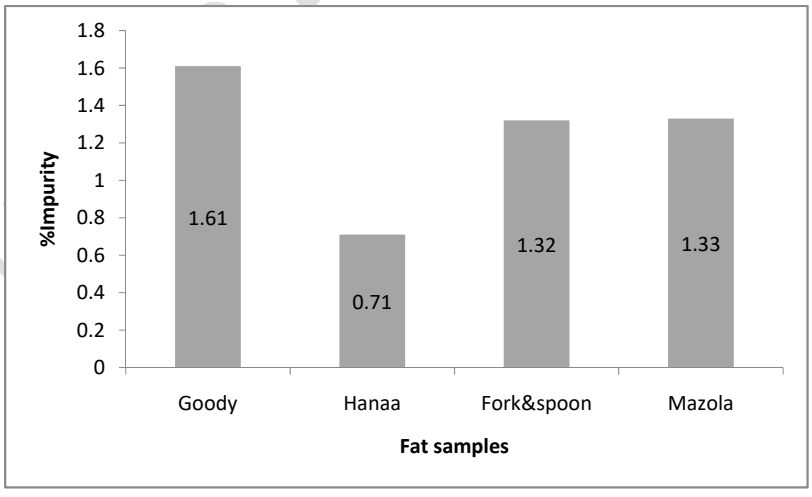

Fig. 5. The impurity for each fat sample.

Table 8. The insoluble impurity for different fat samples.

Samples	Impurity (%)
Goody	1.61
Hanaa	0.71
Fork& spoon	1.32
Mazola	1.33

3.6 Melting point

The melting point for each fat sample was found to be 40±0 , 35±0 , 33.5±0.707 and 39±0 °C for goody, hanaa, fork& spoon, and mazola, respectively as shown in Fig. (6) and Table (9). The lowest melting point was found in fork& spoon fats because it only has pure palm oil and the highest was found to be in goody because it mixture of soybean oil, hydrogenated palm oil and palm oil. All the melting points for different fat samples within the limit, (the highest MP 43.5 °C).

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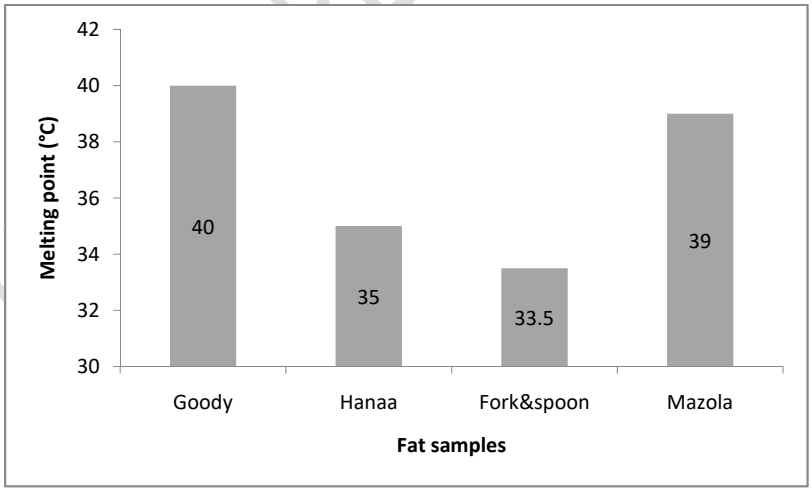

Fig. 6. The melting point for different fat samples.

Table 9. The melting point for different fat samples.

Samples	Melting point (°C)
Goody	40±0
Hanaa	35±0
Fork& spoon	33.5±0.707
Mazola	39±0

4-Conculusion

In this project, four different fat samples was analyzes to determine the percent of moisture, acid value, percent of free fatty acid, peroxide value, insoluble impurities and melting point. According to the work, the moisture and melting point of goody is the highest while fork& spoon is the lowest. However, the acid value and free fatty acid of fat samples has been determine and found that mazola is the highest while goody is the lowest. The peroxide value was found to be the highest value in mazola while the lowest value in fork& spoon. On the other hand, the insoluble impurities of goody is the highest while hanaa is the lowest. The percent of moisture, acid value, free fatty acid percent, peroxide value and melting point compared with the values in literature reviews and found to be in limited range. However, the insoluble impurities were found slightly increase than the range except in hanaa.

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