Original Research Article

Quality Analysis for Different Samples of Fats

ABSTRACT

Fats and oils are essential in human nutrition, and an important component of many foods where they significantly contribute to product quality. The quality of different samples of fats from various companies in Saudi Arabia was determined based on its physicochemical properties such as melting point, moisture, acid value, free fatty acid, peroxide value and insoluble impurities. Four samples 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.eqO_2/Kg for goody, hanaa, fork &spoon, and mazola, respectively. The percent of 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.

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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

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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].

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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Fats and oils belong to a group of biological substances called lipids, which are biological chemicals that do not dissolve in water. They are share a common molecular structure, these structural formula shows that fats and oils contain three ester functional groups, which are esters of the tri-alcohol, glycerol (or glycerine). Therefore, fats and oils are commonly called triglycerides, although a more accurate name is triacylglycerols. One of the reactions of triglycerides is hydrolysis of the ester groups as shown in Fig. (1) [3].

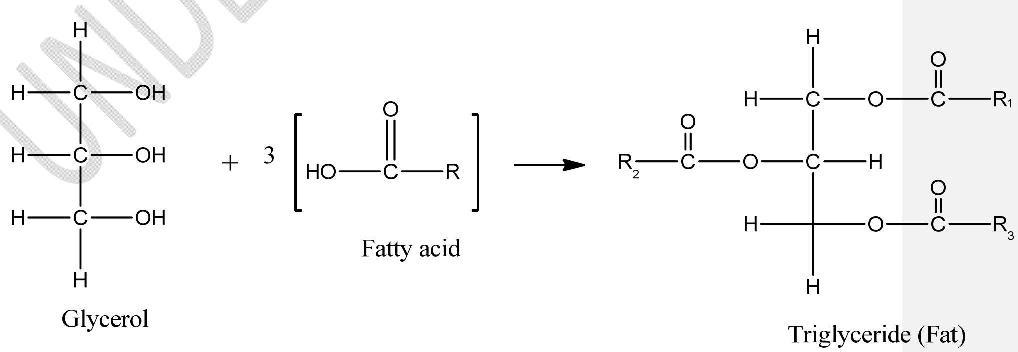

Fig. 1. Reaction for formation of fat.

The main components of edible fats and oils are triglycerides. The minor components include mono and di glycerides, free fatty acids, phosphatides, sterols, fat soluble vitamins, tocopherols, pigments, waxes, and fatty alcohols [4].

There are many different types of dietary fats and oils, these include saturated fats, monounsaturated fats, polyunsaturated fats and trans fats. All fats and oils contain a mixture of saturated and unsaturated fats, but in different amounts. In general, solid fats contain a greater proportion of saturated fats than do liquid oils.[5-12]

Oils and fats subjected to a series of processes to increase their area of use by altering their fatty acid and/or triglyceride compositions. The physical and chemical properties of the starting oil change considerably at the end of such processes. These processes called fat modification techniques. In the oil industry, three modification techniques are commonly used: hydrogenation, interesterification and fractional crystallization[13]. Hydrogenation is the oldest and most widely used process in the oil industry, since's 1900 for various fat modification purposes [14,15].

The aim of the work is to determine quality of different fat samples from different manufactures by determination of physicochemical parameters such as Color, melting point, moisture, acid value, free fatty acid, peroxide value and insoluble impurities and comparison of these values with the standard limit.

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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. Name, expiry, manufacture date 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

2 g of NaOH was weighed and dissolved in little amount of deionized water and transferred to 500 mL volumetric flask and shacked well [16].

2.2.2 0.01N $Na_2S_2O_3$ solution

2.5g of sodium thiosulfate was weighed and dissolved in little amount of deionized water that has been previously boiled and cooled. Transferred to 1000 mL volumetric flask and mix the solution by continuous shaking[17].

2.2.3 0.01N $K_2Cr_2O_7$ solution

0.49g potassium dichromate was was weighed and dissolved in little amount of deionized water and transferred to 1000 mL volumetric flask and shacked well [18].

2.2.4 Phenolphthalein indicator (acid/Base indicator)

1g of phenolphthalein was weighed and dissolved in 100 ml of 95% ethanol solution [19] .

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°C for 3 hour) [20]. 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

It is used to determine the FFA level in the oil sample. According to ASTM-D974, acid value is calculated using the formula below [21]

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

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 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[22].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.

2.3.4 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 in samples [23] was calculated by using the following formula:

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

2.3.5 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 [24].

3. Results and discussion

3.1 Moisture

The moisture content of fats and oils is an important quality parameter, as water not only influences edible oil refining and processing operations but also influences the stability of oils during storage.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. (2). The highest moisture percent was found to be in goody fat and the lowest percent was found in fork& spoon fat. All the percent of moisture for different fat samples within the limited range (less than 0.5%).

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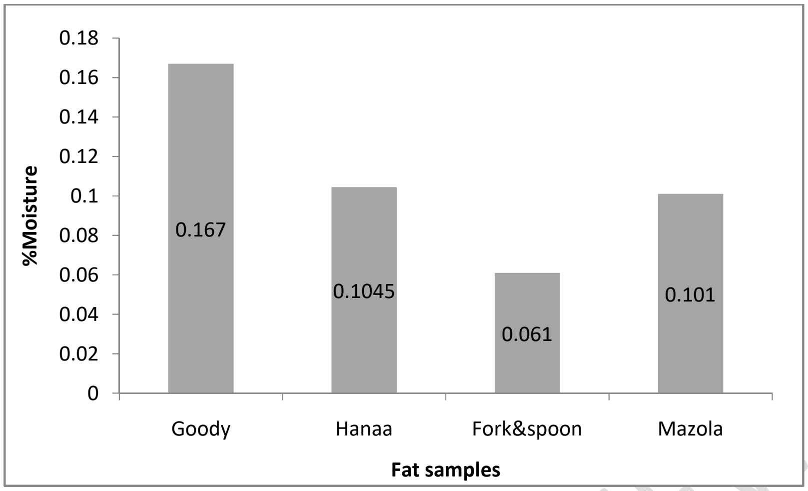

Fig. 2. The moisture for different fat samples.

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. (3). 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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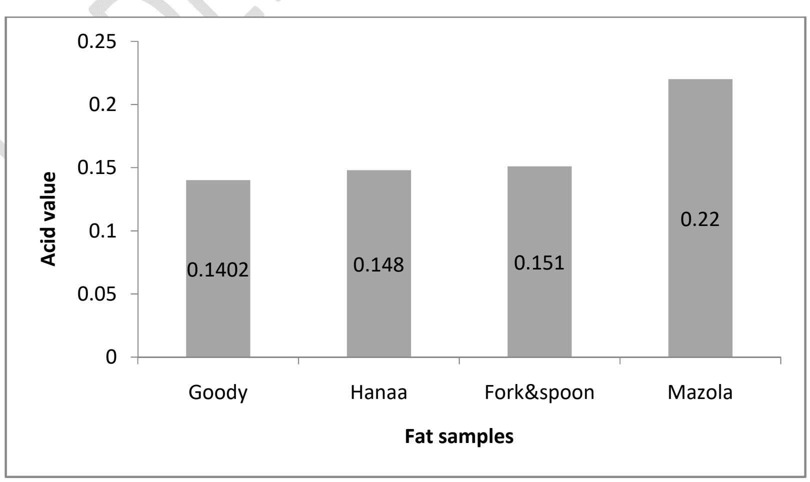

Fig. 3 The acid value for each fat sample.

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. (4). 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%).

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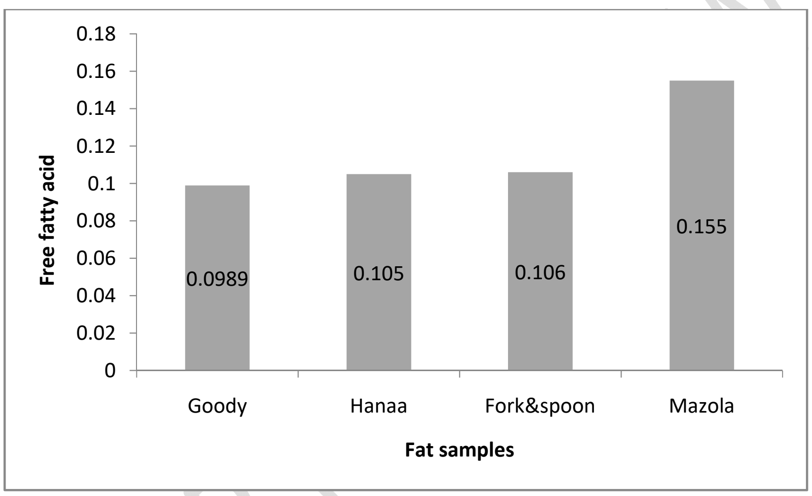

Fig 3. The percent of free fatty acid for each fat sample.

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. (5). The highest peroxide value was found in mazola fat and the lowest value was found in fork& spoon fat. All the peroxide values for different fat samples within the limited range (0 -12).

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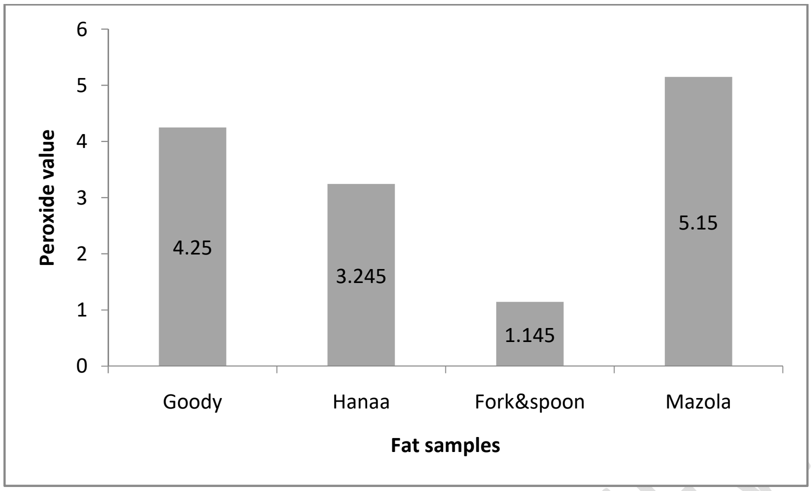

Fig 5. The peroxide value for different fat samples.

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.(6). The insoluble impurities found to be slightly increase than the ideal range (lower than 1%) expect in hanaa.

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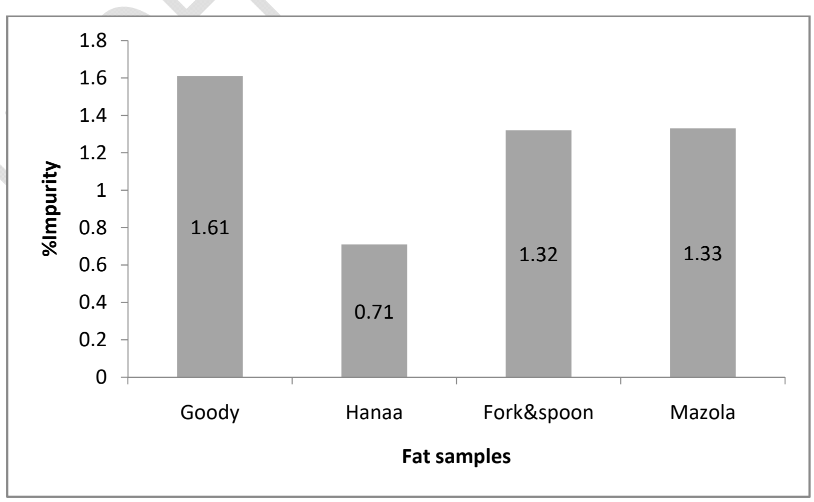

Fig. 6. The impurity for each fat sample.

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. (7). 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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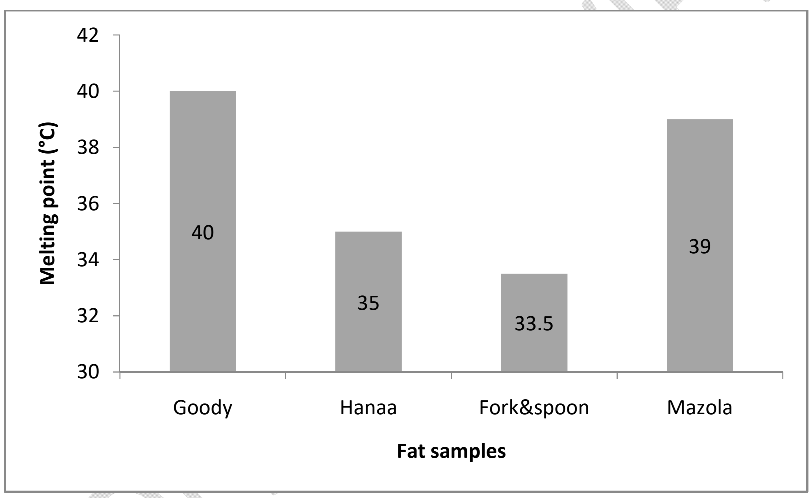

Fig. 7. The melting point for different fat samples.

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. 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 limited range. However, the insoluble impurities were found slightly increase than the range except in hanaa.

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