

EFFECT OF DIFFERENT TYPES OF FATS ON THE QUALITY PROPERTIES OF SOME BAKERY PRODUCTS (CUP CAKES AND COOKIES)

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ABSTRACT : The research aims to study the effect of using different types of fats (fat, butter and oil) on the chemical composition and the quality properties of cupcakes and cookies. The chemical analysis results showed that the fat percentage in a cupcake (treatment A) and cookies (treatment D) increased and reached 27.00 and 29.40 %, respectively. In terms of cake standing height, treatment B (butter %) obtained the highest height of 5.10 cm compared to treatment A (control) that reached to 4.35 cm. As for the flakiness trait of cookies, despite the absence of significant differences between the treatments, it decreased, and the decrease percentage of the treatment E (butter %) reached 10.52%, while the treatment F (oil %) amounted to 21.05 %. As for the sensory evaluation of the cake and texture trait, the treatment B (butter%) obtained the highest degree, which amounted to 8.10 degrees compared to the treatment A (control), which reached 6.30 degrees. While in the tenderness trait, treatment C (oil%) obtained the highest degree, which reached 8.70 degrees compared to treatment A (control), which amounted to 7.20 degrees, in terms of flavor trait, treatment B (butter%) obtained the highest degree, which amounted to 9.00 compared to treatment A (control) which reached 6.10 degrees. Finally, in the sensory evaluation of cakes, treatment D (control) obtained the highest degree in the total sensory properties. Finally, the general acceptance property obtained 8.03 degrees, followed by treatment E (butter %), which obtained 5.80 degrees and then the treatment F (oil %), which obtained 3.33 degrees.

Key words : Fats, quality properties, bakery.

INTRODUCTION

Cupcake and cookies are among the most important bakery products that are used in human nutrition, which are usually eaten with tea, as well as they used to feed infants and even school students. Lipids are one of the most important compounds used in cupcakes and cakes making and are the third-largest ingredients after flour and sugar (Manley, 2000). Moreover, these lipids include fats, vegetable, and animal oils and, which are organic materials insoluble in water and dissolve in organic solvents such as ether, petroleum ether, gasoline and chloroform, carbon tetrachloride and hot alcohol. Furthermore, fats and oils are the cholesterol esters of triacy glycerd, meaning that they consist of an esterification reaction between the glycerol (trihydroxy alcohol). Fatty acids are hydrocarbon chains that may be open, cyclic, or branching, and the number of carbon atoms in them is even or odd, and they are saturated, such as Butyric acid, Caproic, Capric, Caprylic, Palmitic, and Stearic. Alternatively, unsaturated fats contain a number of double bonds ranging from (1-4 double bond) such as Palmitoleic acid, Oleic, Linoleic, Linolenic, and Arachidonic (Al-Muzaffar, 2007; Al-Samahi *et al*, 2011;

Lannes and Ignacio, 2003). Moreover, fats contain high levels of saturated fatty acids and among its properties is that it has a solid or semi-solid consistency at room temperature 21-23°C and it has a high melting point. While oils contain percentages of unsaturated fatty acids, which have a liquid consistency at room temperature and have a low melting point. Liquid oils turn into solid or semi-solid fats with the hydration process that occurs bypassing hydrogen to the oils under special conditions (Al-Muzaffar, 2007). As for butter, it is a food product made by the process of shaking out of milk, cream, or both together. It contains not less than 80% fat and it is called (Milkfat), where the colored materials (pigments), primer and salt are used in its manufacturing (Al-Takriti and Al- Khal, 1984; Edwards, 2007). Furthermore, Butter has two types: salted butter, which contains no less than 80% fat, 16% water, 1.5% solids in milk, solids and salt 2.5%. As for the fats in the butter they are (Triglycerides) and other soluble compounds, such as sterols and fat-soluble vitamins, which are vitamin (A, D, E and K), phosphatides or Lecithin and coloring matter, which are approximately 0.2%. As for the unsalted butter, it is fresher and sweet in taste without any salt addition (Hui *et al*, 2006). Salty

butter is used in making pastries and is eaten directly with bread and jam at breakfast, while the unsalted butter is used in the making of cake (Cox, 2011; Holly and Berry, 2010). Some of the fatty acids present in butter are Butyric acid and Linoleic acid (Belitz *et al*, 2009; Hui *et al*, 2006). As for vegetable oils, it contains a large amount of Linolenic acid, and in animal fats are found in a smaller amount, and Arachidonic acid is found in animal fats only (Al-Samahi *et al*, 2011). The human body needs fats about 2-4 tablespoons daily, it provides the body with the energy necessary to carry out life activities, as one gram gave 9 calories (ADA, 2005). It also provides the body with essential fatty acids necessary for brain development (AKOH, 1998; Al-Shabibi *et al*, 1999). Furthermore, fat is an important source of fat-soluble vitamins (vitamin A, D, E, and K) that are necessary for the body, where the human body needs fat to efficiently absorb these vitamins (Al-Tikriti and Khal, 1984; AKOH, 1998; Moncel, 2014). However, fat enters the body's cells, as it works to protect cells by surrounding them in membranes, where cells cannot play their role without having strong membranes. As well as, fat is involved in most of the body hormones synthesis, which works to regulate the body's functions. The body needs fat in order to regulate the production of sexual hormones and that severe body fat shortages lead to menstrual disorders in women. Fats also enter the sex hormones synthesis that regulates the reproductive process, and fat deficiency in the body leads to a decrease in the fertility rate for men and women. Additionally, it plays an important role in skin health, where one of the main symptoms of a fatty acid deficiency in the body is skin infections, dryness and cracking, which present as a layer beneath the human skin; it eliminates the body from feeling cold. Moreover, it works as a protective pad for the body organs from injury, especially the heart and kidneys, where fatty acids play an important role in treating some heart diseases and reducing cholesterol and lipids in the blood. One of the fattest benefits for the body is that it relieves a human from depression and improves mood, where the human brain needs healthy fats such as 3-Omega. Fat works to prevent cancer and strengthen the teeth bones and reducing the risk of osteoporosis, as it strengthens the immune system of the body and improves eye health and preserves it and increases the amount of muscle in the body (Al-Samahi *et al*, 2011). Likewise, fats give a human a feeling of satiety when consumed, because they digest for a longer period than carbohydrates and proteins, which gave the emulsions for some food products, where the cake is an emulsion of oil in water. As well as, the fat gives a characteristic of heat transfer, as the oil has a great ability

to transfer heat to food surfaces (Moncel, 2014). Hussein *et al* (2011) produced a low-calorie cake by replacing fats with artichoke, and replacing sugar with the commercial sweetener in different percentages. Singh (2012) used the flour-oil composite made from wheat flour and canola oil as a dried fatty source in mixtures of low-fat cake. As for the cookies, the word origin is English and has a larger shape and chewy consistency (Cox, 2011). Armbrister *et al* (1994) were made a chocolate chip cookies with vegetable shortening instead of fats at 50-75% replacement rates, and studied their physical and sensory properties. Furthermore, Hayek and Ibrahim (2013) also made chocolate chip cookies using applesauce instead of butter with various replacement rates in order to increase consumer acceptability. Zohng (2013) used butter, lard, margarine, all-purpose shortening and soybean oil in making cakes and cookies. Chugh *et al* (2013) used carbohydrates (maltodextrin and guar gum) instead of fats in making low-fat soft dough biscuits. Masih *et al* (2014) used Linins oil extracted from *Linum usitatissimum* in making cakes by adding different percentages. Rois *et al* (2014) used fats in making cakes and cookies. Sarba *et al* (2015) used shortening fats in making wafer filings and biscuits and studied the differences between them. Finally, Aslam *et al* (2018) made cookies using white sesame seed oil instead of hydrogenated fats and studied their physical, chemical and nutritional properties. The research aims to study the effect of different fats (fat, butter and oil) on making cupcakes and cookies, and study their sensory properties, the standing height of the cake and the flakiness trait of the cake.

MATERIALS AND METHODS

Wheat flour (deluxe) with an extraction rate of 72% from Al-Rayhan mill in Diyala governorate, and hydrogenated fat (Janah trademark, butter (the Almarai trademark) and corn oil (Alafia trademark) supplied from the local market were used to make Cupcakes and Cookies according to the following percentages:

Percentages	Treatment symbol
Cupcake	
100% fat (control)	A
100% butter	B
100% oil	C
Cookies	
100% fat (control)	D
100% butter	E
100% oil	F

Cupcake making

The following materials were used in making the cake as follows: 190 g flour, 96 g, hydrogenated fat

(Shortened), 200 g sugar, 96 g egg albumen, 108 ml milk (fat-free), 2.9 g baking powder, 1.2 ml vanilla. The cupcake was prepared in a creaming method according to Campbell *et al* (1979) procedure, by mixing fat and sugar together until it became cream, then adding egg albumen and vanilla with continuous mixing, then added the flour and baking powder with the milk alternately and mixed well. Moreover, the dough was formed, which was placed in small, greased molds with a diameter of 5 cm, then baked in an oven with a temperature of 180°C for 25 minutes, the cake removed from the oven and cooled in the room temperature.

Making cookies

The following materials were used in making cookies as follows: 300 g flour, 80 g sugar, 120 g fat, 25 g egg albumen, 12 g baking powder, 5 ml vanilla. The cookies were prepared in a creaming method according to what Al-Adeeb and AL-Mukhtar (2004) procedure by mixing fat and sugar together until it became cream. Subsequently, egg albumen was added and vanilla while mixing continued, then added the other dry ingredients (flour and baking powder) and mixed well for one minute, then the dough was placed into cookie molds with a diameter of 5 cm and baked in an oven with a temperature of 175°C for 10-15 minutes, and were removed from the oven and cooled in the room temperature.

Chemical analysis

In chemical analysis, the fat content was estimated by the Soxhlet device according to A.O.A.C. (1984) procedure, where the Chloroform, Hexan and Ethanol were used in a ratio of 1: 1: 1 solvent to the extraction for 8 hours.

Standing Height (S.H.)

The cake standing height was measured according to the booklet issued by the Department of Food and Nutrition-Kansas State University (1975), where a slice of cake 2 centimeters thick was cut off, put it on a paper, and determined its shape with a pencil. Then painted three columns, one in the center of the slice and the other on each of the right and left halves of the slice and in almost symmetrical locations, and the lengths values were divided on the number of columns to get the average number that represents the standing height. Finally, the percentage of increase and decrease in the cake standing height was calculated according to the following:

$\text{Increase\%} = [(\text{Treatment} - \text{Control treatment}) / \text{Control treatment}] \times 100$

$\text{Decrease\%} = [(\text{Control treatment} - \text{Treatment}) / \text{Control treatment}] \times 100$

Cakes Flakiness (C.F.)

The flakiness of cakes has been measured according to the booklet issued by the Department of Food and Nutrition - Kansas State University (1975), where three pieces are taken and placed one over one, and measured the cake's height (in centimeters) using a ruler.

$\text{C. F} = \text{Height of three biscuit pieces} / 3$

Sensory evaluation

Ten evaluators' specialists according to the approved evaluation form from the Department of Food and Nutrition (1975) in terms of sensory properties that included the appearance, texture, tenderness, carried out the sensory evaluation of the cupcake. As well as, the flavor and general acceptance fixed in the form, and for each property, at evaluation were given seven degrees out of 35 total degrees. While ten evaluators specialists and the cookies conducted the sensory evaluation of the cookies were evaluated in terms of sensory properties that included appearance, color, crunch, texture, and flavor (taste and odor). Finally, the general acceptance and the preference balance were calculated from nine (liked extremely) to the lowest degree, which is one (disliked extremely) and degree five (neither liked nor disliked).

Statistical analysis

The research results were analyzed using the Completely Randomized Design (CRD) to study the effect of different fats (fat, butter, and oil) in the studied traits in this research. Then, Duncan's multiple range test was used to determine the significant differences between the variables at the probability level (0.05) (Al-Rawi and Khalaf Allah, 1980) by using the statistical analysis system SAS (2000).

RESULTS AND DISCUSSION

Table 1 shows the percentage of fats in different cupcakes and cookies. In cupcake, the results indicate that there was a significant difference between treatment B and treatments A and C, as the fat percentage for treatment B was 17.00%, and for treatments A and C were 27.00 and 25.10%, respectively. In cookies the results indicate that there was a significant difference between treatment E and treatments D and F, as the fat percentage for treatment E was 18.60% and the fat percentage for treatments D and F was 29.40 and 27.40, respectively. A decrease in the fat percentage in treatment B and E was observed due to the use of butter in their manufacture, as butter contains a percentage of milk fat (which is saturated fatty acids, including Butyric acid, Caproic, Capric, Caprylic that dissolve in water and are volatile fatty acids (Al-Mudhafar, 2007). Butter also

contains yogurt, salt, and water in its composition (Al-Tikriti and Khal, 1984). While treatment A and D contain fat (which is a saturated fatty acid with a high melting point, including Palmitic and Stearic), treatment C and F contain oil (which is an unsaturated fatty acid with low melting point (Al-Mudhafar, 2007).

The S.H. results of different cupcake models in Table 2 indicate that there were a significant difference between treatment B and C, where treatment B got the highest S.H which reached 5.10 cm and the increasing percentage was + 17.24% compared with the control treatment A. This may be due treatment B contains butter and when mixing the butter with sugar and conducting whipping, a creaming process is occurring, which allows the air to enter inside the dough components in addition to the air that entered while sifting the dry ingredients involved in making the cake. Furthermore, butter contains fat that is characterized by plasticity, crystals, spread and lubrication, where the fat covers the flour particles that detention the air bubbles forming between the dough folds and prevent them from flowing. When baking, the air bubbles expanded, enlarge and contribute to raising the size of the cake (Rois *et al*, 2014; Manley, 2000) and this was consistent with what Holly Wood and Berry (2010) and Zohng (2013) have indicated. As well as, the butter also contains milk proteins and a percentage of Lactic Acids that interact with soda (Na_2CO_3 sodium bicarbonate) added to the cake components that lead to producing CO_2 gas that contributes to raising the size of the cake during the thermal transfer between the dough folds. Similarly, it released a percentage of CO_2 gas from baking powder that added to the cake mix and the presence of H_2O water vapor released from the liquid ingredients interred in making a cake that contributes to raising the volume of the cake (Lakshmi *et al*, 1984; Czernohorsky and Hooker, 1975). As the Nordic Sugar Foundation members also mentioned that sugars such as glucose, fructose, and sucrose give an increase in the size of bakery products. Finally, the treatment C achieved 3.60 cm and the decrement percentage was 17.24-% compared to the control treatment A because the treatment C contains oil, which is amorphous liquid and it is not possible to detention the air bubbles formed between the folds of the dough. Therefore, it flowing, as the crystallization of fat has a great role in keeping the air between the folds of the dough, where water vapor escapes when the baking cake in the oven (Rois *et al*, 2014; Hui *et al*, 2006).

Table 3 shows the flakiness of the different cookies models, where the results indicate a decrease in the flakiness trait between the treatments. The treatment D (control) achieved the highest degree reached to 1.93

Table 1 : shows the percentage of % fats in different cupcake and cookies models.

Treatments	% Fats
Cupcake : A	27.00a±0.40
B	17.60b±0.48
C	25.10a± 0.77
Cookies : D	29.40a±0.24
E	18.60b±0.28
F	27.40a±0.24

* S.E. Standard error.

** Average of three replicates.

*** Different letters indicate that there are significant differences between treatments at the probability level (0.05).

Table 2 : Standing height for different cupcake models.

Treatments	Standing height (cm)	%
A	4.35ab±0.02	----
B	5.10a±0.04	17.24+
C	3.60b±0.16	17.24-

* S.E. Standard error.

** Average of three replicates.

*** (+) indicates the increasing percentage in the cake standing height

(-) Indicates the decrement percentage in the cake standing height.

**** Different letters indicate that there are significant differences between treatments at the probability level (0.05).

Table 3 : Flakiness for different cupcake models.

Treatments	Flakiness	Decrease %
D	1.93a±0.02	---
E	1.73a±0.11	10.52
F	1.53a±0.19	21.05

* S.E. Standard error.

** Average of three replicates.

*** Similar letters indicate that there were no significant differences between coefficients at the probability level (0.05).

cm because it contains the crystallized fats that are characterized by plasticity, stability, and lubrication. In addition to the fat covers the flour particles, that detention the air bubbles formed during mixing between the dough folds and preventing them from escaping, as well as the air that entered during sifting the dry ingredients involved in making the cake. Once baking, the air bubbles expand, enlarge and contribute to the flakiness trait of cookies (Zohng, 2013; Hui *et al*, 2006; Dwyer and Gallagher, 2001). In addition, when fat covering flour particles, it reduced the development of Gluten (a protein that results from the fusion of gliaden with glutinine) (Rois *et al*, 2014; Manley, 2000) during the dough mixing. This may be due to the shortening properties of the fats that contribute to the flakiness trait of the cookies, where the Flakiness are thin layers of baked dough separated by open spaces (Ifas, 2006; Hui *et al*, 2006). Treatment E recorded a degree of 1.73 cm, because it contains butter, which contains water, and not less than 80% of crystallized fats and its percentage is less, therefore, shortening properties of fats be less and cause a little development of gluten.

As for the treatment F, it recorded 1.53 cm, because it contains the oil, which is an amorphous liquid, and it cannot detention the air formed between the dough folds (Al-Tikriti and Al-Khal, 1984; Hui *et al*, 2006). This was consistent with Masih *et al* (2014) findings, where the cake thickness is decreasing by increasing the percentage of replacement of Linseed oil.

Table 4 shows the sensory evaluation of the different cupcake models, where the results indicate a significant difference between the two treatments A (control) and B with the treatment C, as the treatments A and B achieved 8.20 and 5.90 degrees, respectively. While the treatment C got 3.00, this was because treatment C contains oil, and the produced cake has an oily appearance, especially on the crust, and the crust is sticky, shiny and not separated from the pulp, this is consistent with what Hui *et al* (2006) stated. As for treatment A, it achieved the highest degree because it contains the fats that improve the properties of the cake external crust and the crust is less thick. The fat helps in obtaining the brown color desired by the consumer (Ifas, 2006). As for treatment B, it contains butter, which contains fat and solid milk components such as proteins. As well as the presence of starch in the flour and the presence of table sugar (sucrose) that leads to forming the brown color as a result of non-enzymic brown color reactions, including Maillard reactions and sugars Caramilizations reactions (Al-Tikriti and Khal, 1984; Al-Mudhafar, 2007; Member of Nordzucker group). In the texture trait, a significant difference was observed between treatments A (control) and B with treatment C at the highest degree, which amounted to 8.10, because it contains butter, which contains milk fats. Furthermore, the treatment A got 6.30 degrees, and it contains fats that are soft and spread easily and covered flour particles and sugar, and works to detention the air bubbles, water vapor, and CO₂ gas between the dough folds and prevent them from escaping, thus it distributed in the pulp homogeneously (Czernohorsky and Hooker, 1975; Hui *et al*, 2006). In addition to containing fat, the emulsification materials that help to catch the largest amount of liquid and sugar and thus gives a smooth texture (Hui *et al*, 2006), this was consistent with what Rois *et al* (2014) indicated that fat has a role in texture. While treatment C achieved 2.60 degrees and it contains oil that cannot detention air bubbles, water vapor and CO₂ between the dough folds and does not prevent them from escaping so the pulp become pressed, and the distribution of air spaces in it is heterogeneous (Czernohorsky and Hooker, 1975; Hui *et al*, 2006). In the tenderness trait, there are no significant differences between the treatments, where the treatment

C has achieved 8.70 degrees, followed by treatment A (control) and treatment B. This was due to treatment C contains oil that works on softening through the shortening trait (preventing the development of Gluten, as the fat covers flour particles and prevents the development of Gluten, which gives the characteristic of strength and hardness for the product). In addition, oils have the ability to emulsify more than solid fats and thus give more tenderness and moist products (Hui *et al*, 2006). Treatment A got 7.20 degrees because it contains fats that work to softening the product through the shortening characteristic, and this is consistent with what (Singh, 2012 and Zohng, 2013) pointed out. As for treatment B, it got 6.60 degrees because it contains butter, which works to soften through the shortening trait. While flavor trait (which includes taste and odor), there was a significant difference between treatment B and C. The treatment B obtained the highest degree, which amounted to 9.00 because it contains butter that contains fat and solid milk components, which gave flavor to the product and this is consistent with what Manley (2000) findings. Moreover, treatment A (control) got 6.10 degrees because it contains fat, and this consistent with (Singh, 2012 and Rois *et al*., 2014) mentioned, that fats contribute in the product flavor. In the general acceptance trait, there are no significant differences between treatments A, B, and C, but treatment B obtained the highest degree, which amounted to 7.40 degrees., followed by treatment A (control) and treatment C, this indicates the improving effect of butter on sensory properties overall.

Table 5 shows the sensory evaluation of the different cookies models, where the results indicate that there were a significant difference between the control treatment D with E and F treatments. As the treatment D obtained the highest degree, which amounted to 8.10 degrees, and had a desirable appearance and brown color, because it contains fat that forming the brown color (Ifas, 2006). While for the treatment E, it achieved 5.40 degrees and it was dark-brown color, which is not desirable by the consumer due to it contains butter that contains fat and solid milk ingredients. As well as, the presence of starch in the flour and the presence of table sugar (sucrose) that leads to forming the brown color as a result of non-enzymic brown color reactions, including Maillard reactions and sugars Caramilizations reactions (Al-Tikriti and Al-Khal, 1984; Al-Muzaffar, 2007; Member of Nordzucker group). In the texture trait, it was observed that there was a significant difference between the two treatments D (control) and E with the treatment F, where treatment D achieved the highest degree, which amounted to 7.00. This is due to it contains the fat that improves

Table 4 : Sensory evaluation for different cupcake models.

Sensory eval. Treatment	Appearance and color	Texture	Tenderness	Flavor	General acceptance
A	8.20a±0.49	6.30a±0.28	7.20a±0.32	6.10ab±0.62	6.95a±0.80
B	5.90a±0.31	8.10a±0.36	6.60a±0.16	9.00a±0.28	7.40a±0.88
C	3.00b±0.28	2.60b±0.16	8.70a±0.53	4.30b±0.50	4.65a±0.36

* S.E. Standard error.

** Different letters indicate that there are significant differences between treatments at the probability level (0.05).

Table 5 : Sensory evaluation for different cookies models.

Sensory eval. Treatment	Appearance and color	Crunch and texture	Flavor	General acceptance
D	8.10a±0.36	7.00a±0.28	9.00a±0.40	8.03a±0.28
E	5.40b±0.16	6.20a±0.05	5.80b±0.08	5.80b±0.30
F	2.90b±0.04	3.50b±0.38	3.60b±0.16	3.33c±0.16

* S.E. Standard error.

** Different letters indicate that there are significant differences between treatments at the probability level (0.05).

the properties of the external crust of the cake and also can detention the air bubbles, water vapor, and CO₂ gas between the dough folds. Thus, it distributed in the pulp homogeneously and the cake becomes soft, this is consistent with what (Czernohorsky and Hooker, 19075; Hui *et al*, 2006, Chugh *et al*, 2013) found. Fats give soft biscuits and this consistent with (Armbrister and Setser, 1994) found that fats in cookies give sensory firmness. Moreover, treatment E achieved 6.20 because it contains butter, which contains milk fats, and treatment F got the lowest degree, which is 3.50 degrees because it contains oil that cannot detention air bubbles, water vapor, and CO₂ between the dough folds. Therefore, the pulp becomes pressed, and the distribution of air spaces in it is heterogeneous and the cookies become hard, and this was consistent with Zohng (2013) indicated. In flavor trait (which includes taste and odor), there was a significant difference between treatment B and C. As treatment B obtained the highest degree, which amounted to 9.00 because it contains butter that contains fat and solid milk components, which give flavor to the product, and this was consistent with Manley (2000) findings. Additionally, treatment A (control) obtained 6.10 degrees because it contains fat, and this was consistent with Singh (2012), Rois *et al* (2014) mentioned, that fats contribute to the flavor of the product flavor. In the general acceptance trait, it was observed that there were no significant differences between treatments A, B and C, but treatment B obtained the highest degree, which amounted to 7.40 degrees, followed by treatment A (control) and treatment C and this indicates the improvement effect of butter in the overall sensory properties.

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