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## RESEARCH ARTICLE

### STUDY OF THE EFFECT OF DIFFERENT TYPES OF SUGAR AND SUGARS ON THE PHYSICAL, CHEMICAL AND STORAGE PROPERTIES OF CUPCAKES PRODUCED FROM OATS

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#### ABSTRACT

The study was conducted in the laboratories of the College of Agriculture, Department of Food Science, and included the production of cupcakes from oats with different types of sugar, with the aim of comparing the physical, chemical and rheological properties, the degree of turbidity, and the degree of gelation for the different treatments. Various samples were taken from the cupcakes produced from oats by replacing white sugar with brown sugar, dansin, and stevia sugar. The results of the physical characteristics showed a high moisture content in oat cupcakes with stevia added. And a reduction in cupcakes with added brown sugar. The percentage of fat also increased in cupcakes to which brown sugar was added, and decreased in cupcakes with white sugar. The highest ash value was found in white sugar cupcakes and the lowest in students. The highest value of carbohydrates was found in the brown sugar cupcakes. We also notice that the brown sugar cupcakes had superiority in turbidity and the lowest in the students' cupcakes. As for the measurement of gelation, the standard treatment cupcakes surpassed them, and the lowest value of gelation was in the academics' cupcakes and stevia sugar.

## INTRODUCTION

Grains and their products constitute an important part of the human diet, as they provide a high percentage of carbohydrates, proteins, fats, dietary fiber, B vitamins, and minerals. There are many foods made from latent grains that contain these benefits (Liu, Okarer, 2010). Given the benefits of new knowledge in food science and new scientific technologies, consumers are demanding foods with multiple health benefits. The focus is also on preventing disease and improving health through the use of functional food ingredients. Functional foods have been defined as foods and nutritional components that provide a health benefit beyond basic nutrition to consumers (Ibne Anwar, 2013). Oats have recently attracted research and commercial interest due to their universal nutritional value, as they are considered a good source of vitamin E and the antioxidants phenolic acid and avantranamides, in addition to containing high levels of High in protein and fat (unsaturated fatty acids), oats are also well accepted in human nutrition and are an excellent source of  $\beta$ -glucan, cellulose, and arabinoxylans. Studies have also shown that  $\beta$ -glucan has an effect on blood sugar and insulin responses (it has an effect It is positive for hyperinsulinemia and cholesterol (it also works to reduce cholesterol) (Ahmed et al., 2014). Oats are one of the most important foods rich in fiber that can be used in the fortification process and the production of complex flour due to their high content of dietary fiber, vitamins, and minerals (Rasane 2015).

It may be a very useful type of flour in preparing many functional foods that cover the health needs of the consumer. It has been found that high-fiber additives directly or indirectly affect the physical and functional properties of the final product. This necessitates studying the chemical, functional and nutritional properties of the compound flour to be used. In the appropriate industry (Gupta, 2010), the oat grain has a high content of dietary fiber (35%), and the dissolved fiber in water represents approximately one-third, the most important of which is the beta-leucane compound, which reaches 5.5%. The oat grain also contains a high percentage of protein ( 16.5%), which is characterized by its high biological value and high solubility in water compared to other grain proteins (Ahmed, 2014). It should be noted that oats are manufactured on the basis of whole grain products due to the softness of the grain and the high percentage of fat, as it is not easy to divide the grain into its components of The embryo, endosperm, and cortex have been used in the preparation of many food products known as functional foods, such as cakes, bread, baby food, and others (Majzoobi, 2015). Oats are considered a healthy crop because they contain active peptides that may have health effects such as anti-cancer and anti-inflammatory, including immune and muscle-stimulating peptides (Gangobadhayay, 2015). In addition, oats contain natural antioxidants that play a role in protecting body tissues from oxidative stress, the most important of which are tocopherols ( Sterna, 2016) and phenolic acids, flavones, and phytic acid (Liu, 2004).

Experiments also found their ability to protect oat products and some other food products from oxidation during storage (Decker, 2014). Oats also have a high content of minerals (2-3% total ash). And some water-soluble vitamins, most notably folate and pantothenic acid (Sangwan 2014). Oats contain a higher amount of nutrients, including vitamins, minerals, and fiber, compared to processed grains. This is because it is considered a whole grain, Barbie Cervoni (2020), as it is rich in phosphorus, vitamin B1, or what is known as thiamin, magnesium, and zinc. It also contains vitamin B5, or what is known as pantothenic acid, manganese, copper, and folate. Oats contribute to maintaining health. However, studies differ in the extent of its effectiveness in reducing the risk of heart disease due to the different types of studies and the different types of oats used in each study. It has been shown that eating whole grains helps reduce the risk of heart disease (Gang Tang et al. 2015), as a comprehensive analysis showed. Another published in the Journal of Nutrition in 2011, which included 126 clinical studies, showed that eating three grams of beta-glucan fiber found in oats or barley daily may contribute to reducing blood levels of cholesterol in general, and harmful cholesterol, or what is known as low-density lipoprotein, in particular. In addition to a decrease in triglyceride levels (Tiwari & Cammins (2011), eating whole oat grains and oat bran may contribute to reducing the risk of stomach cancer. A preliminary study has shown that eating fiber found in grains may contribute to reducing the incidence of esophageal and stomach cancer. Paul Terry et al., 2001). People with irritable bowel syndrome usually suffer from constipation or occasional diarrhea. It has been found that eating some types of foods may reduce or increase the severity of these symptoms. Oats are among the foods that may help in cases of constipation. As it contains a good amount of fiber soluble in water, which forms a gelatinous mass in the intestine after eating it, which may reduce intestinal cramps. It is worth noting that oats also contain a small amount of fiber insoluble in water, which would increase Bowel movement (Prasadkerkar 2017), and eating whole grains such as oats usually helps reduce inflammation in general, including arthritis, Kerri Ann (2014). Oats contain beta-glucan fibers dissolved in water, which may help improve the body's response. For insulin and reducing blood sugar levels, it is therefore recommended for people with type 2 diabetes to include oats in their daily diet, as oats are potentially effective in helping them control blood sugar levels, according to a systematic review that included 14 preliminary studies.

It was published in the Nutrients magazine in 2015, and oats are an excellent source of energy for children's brains, as they are rich in vitamin E, a group of B vitamins, and zinc, which enhance brain function. Oats also contain a high amount of fiber that makes the child feel full and satisfied, which reduces the chance of eating it. For unhealthy foods between meals (Marilyn Ball et al. 2014, oatmeal is one of the best foods allowed to be eaten during pregnancy; it is safe for the mother and her child, and it contains many useful nutrients that provide the pregnant woman with energy during her day, such as complex carbohydrates that decompose slowly, Which increases the feeling of satiety for a longer period and reduces the risk of developing gestational diabetes., NjoudJweihan (2019), and whole oatmeal and oat bran are often safe for most people, including pregnant and lactating women, when consumed in the amounts found in foods, and despite that, eating oats may It causes the formation of gases in the intestines and bloating, but these symptoms gradually decrease when the body gets used to oats (Oats, 2018). ) and digestive disorders: which include the esophagus, stomach, and intestines (Oats) (2019). There are also cases of oat allergy that appear in some people when eating oats, because it contains a protein called avenin, which may lead to the appearance of red spots on the body, and a runny nose. For those who suffer from sensitivity towards it (Corey Whelan, 2018). Based on the foregoing, the aim of this study was to use oat flour in the preparation of compound flour for the production of cake to overcome the deficiency in the nutritional value of white wheat flour and the possibility of exploiting this distinct and available food crop and to study its effect on the quantity and quality of gluten, and the percentage of total ash in white flour and its properties

Functional factors that directly affect the use of compound flour in diets and replace sugar in cupcakes on the chemical and rheological properties of ketogenic cupcakes.

**Materials and methods of work:** The method of preparing cupcakes: preparing three treatments of ketogenic cupcakes fortified with different treatments of sugar according to the method ( Position of The Americans, 2004). The ingredients were mixed manually in a stainless steel bowl with a spoon for five minutes. Then put the homogeneous dough on silicone shapes with dimensions (7, 6, 3 cm), then transfer it to a high-power microwave for five minutes. Then cool the products to room temperature. Remove them from the silicone forms and store them properly until analysis.

#### Chemical tests conducted on cupcakes

**Moisture:** Determination: Moisture percentage was estimated according to the aforementioned method (2019, A.O.A.C) using a Rapid moisture test device at a temperature of 105°C until the weight is proven.

**Determination of Fat:** The percentage of fat was estimated according to the method mentioned in (2019, A.O.A.C) using the Soxhlet extraction device using petroleum ether.

**Protein estimation:** The protein percentage was estimated by the microcalculator method according to what was mentioned in A.O.A.C (2019), then the amount of nitrogen produced was multiplied by a coefficient of 6.38 to extract the protein percentage.

**Determination of ash:** I followed the standard method mentioned in (A.O.A.C, 2019) at a temperature of 550 °C, and the samples were left until a whitish-gray color was obtained.

**Estimation of carbohydrates:** Carbohydrates were estimated mathematically by the method of the difference between the components (moisture, fat, protein and ash) subtracted from the 100 mentioned in (2019, A.O.A.C) according to the following equation.

$$\text{Total carbohydrates} - 100 = \text{moisture \%} + \text{fat \%} + \text{protein \%} + \text{ash \%}$$

**Sensory evaluation of the cupcake:** The sensory evaluation of fresh laboratory cake was carried out according to the evaluation form shown in the figure, and the scores were distributed according to what was mentioned by Ayoubi and Porabolghasem (2019). The evaluation was conducted by fifteen assessors from the teaching and students of the Department of Food Science.

**Penetration measurement:** It was estimated using a penetrating device whose image is in Appendix (1). According to the method mentioned by Al-Hadithi (2020), the penetrability of the cake was estimated during storage by using a (local) device to estimate penetrability by measuring the depth distance in millimeters caused by the metal cone installed in the device by The measuring ruler installed on its side.

**Turbidity measurement:** Examining turbidity can give a qualitative description of the phenomenon of starch retrogradation. It can also be used to identify the effect of storage on this process and has been used by many researchers in this field (Jacobson et al. 1997 / Błaszczuk et al. 2001).

## RESULTS AND DISCUSSION

**Chemical composition of cupcakes:** Moisture: Table (2) shows the chemical composition of the cake made by adding several types of sugar (white sugar, brown sugar, stevia), where the results showed a high percentage of moisture in the students' sample, reaching (28.4%), and the lowest percentage of moisture was in the brown sugar sample (18.6%) as there was a variation in the percentage of humidity in the different samples (26.2, 18.6/28.4/26.4) respectively. These results do not agree with the results obtained by Abbas (2012), where the percentage of humidity was close, reaching its highest percentage (23.1) and it was

**Table 1. Shows the amount of materials used in preparing cupcakes**

Transaction	Wheat flour	Oat flour	Sugar	Oil	egg	Baking powder	Chia seeds	Sodium bicarbonate
A1	65 g	65 g	120 g	60 g	150 g	5 g	5 g	3 g
A2	65 g	65 g	120 g	60 g	150 g	5 g	5 g	3 g
A3	65 g	65 g	120 g	60 g	150 g	5 g	5 g	3 g
A4	65 g	65 g	120 g	60 g	150 g	5 g	5 g	3 g

A1: Cup cake with added white sugar (table sugar), A2: Cupcakes with brown sugar added, A3: Cupcakes with added students, A4: Cupcakes with added stevia sugar.

**Table 2. Shows the chemical composition of manufactured cupcakes**

Transaction	Moisture	Oil	ASH	Protein	Carbohydrate
A1	21.2	12.5	1.9	7.6	29.8
A2	18.6	13.3	1.2	4.5	41.6
A3	28.5	13.0	1.7	12.2	24.9
A4	30.6	12.7	2.5	16.5	16.6

A1: Cup cake with added white sugar (table sugar), A2: Cupcakes with brown sugar added, A3: Cupcakes with added students, A4: Cupcakes with added stevia sugar.

**Table 3. Sensory evaluation of cupcakes**

Transaction	Color 10	Odor 10	Taste 10	Texture
A1	7.2	7.2	7.5	8.8
A2	6	7.6	6.8	7.3
A3	7	7.5	7.8	8
A4	6.4	6	Zero	5.8

A1: Cup cake with added white sugar (table sugar), A2: Cupcakes with brown sugar added, A3: Cupcakes with added students, A4: Cupcakes with added stevia sugar.

**Table (4) shows the penetration measurement for the samples**

Transaction	Storage period per day			
	First day	the fourth day	Day 8	Day 12
A1	17	16	14	13
A2	17	16	14	12
A3	17	15	13	11
A4	17	15	13	11

A1: Cup cake with added white sugar (table sugar), A2: Cupcakes with brown sugar added, A3: Cupcakes with added students, A4: Cupcakes with added stevia sugar.

**Table (5) Turbidity measurement**

cupcake type	storage periods			
	2 h	24h	48 h	72 h
A1	747.3	701.2	690.2	672.0
A2	1000.0	952.3	917.2	814.2
A3	586.0	500.1	488.1	401.0
A4	656.0	621.9	589.3	461.4

A1: Cup cake with added white sugar (table sugar), A2: Cupcakes with brown sugar added, A3: Cupcakes with added students, A4: Cupcakes with added stevia sugar.

Its lowest rate is (21.9). Ash: Table (2) shows the chemical composition of cake made with the addition of several types of sugar (white sugar, brown sugar, stevia sugar), where the results showed an increase in the percentage of ash in the sample (stevia sugar) compared to the control sample (white sugar), which reached (1.9). There were no significant differences in the two samples (brown sugar and Darsin), where the ash percentage was (1.2/1.7), respectively, and these results are somewhat consistent with the study conducted by (Hemeda.2010). Fat: Table (2) shows the chemical composition of the cake made by adding several types of sugar (white sugar, brown sugar, and stevia). The fat results showed similar percentages and there were no significant differences, as the highest percentage was (13.3) in the brown sugar sample and the lowest percentage was (12.5) in the control sample (white sugar). These results were comparable to what was mentioned (Abbas. 2012). Protein: Table (2) shows the chemical composition of the cake made by adding several types of sugar (white sugar, brown sugar, stevia sugar), where the results showed a significant increase in the percentage of protein in the (stevia sugar) sample (16.5) and the stevia sample, which was (12.2).

The lowest percentage was in the brown sugar sample, which was (4.5), and the results showed significant differences compared to the control sample, in which the percentage of protein was (7.6). These results are completely comparable to the study conducted by (Abbas, 2012).

**Carbohydrates:** Table (2) shows the chemical composition of cake manufactured with the addition of several types of sugar (white sugar, brown sugar, dandelion, stevia). The results showed significant differences in all samples, where the highest percentage was (41.6) in the brown sugar sample and the lowest percentage was in A sample of Stevia sugar reached (16.6), and these results are much lower than what was mentioned (Abbas 2012), where the highest percentage of carbohydrates was (53.6) and the lowest percentage was (49.6).

**Sensory evaluation of cupcakes:** Table (3) shows the sensory evaluation of the produced cupcake, as significant differences were observed from the level of  $p < 0.05$  for the studied characteristics of the treatments, as it was noted that the sensory evaluation was high in color in the treatment white sugar, reaching (7.2), while the color

decreased to (6) in the treatment (sugar Al-Asmar) that the distribution of cupcakes in the oven affects the color in addition to the basic treatment of sugar, which contributes to changing the color, as sugar interacts with amino acids, proteins and peptides in Maillard reactions, which leads to the appearance of dark brown color and flavors. As for the smell, its highest level was in the treatment (brown sugar), which amounted to (7.6), while the lowest level was in the treatment of stevia sugar, which amounted to (6). Adding sugar of different types to the treatments affects the flavor. As for the taste, the highest value was in the treatment of (students), as it reached (7.8), and the lowest value was in the treatment (stevia sugar). it reached (zero). From the sensory evaluation of the treatments, the standard treatment showed the highest value in the texture and the lowest value in the stevia sugar treatment, and this depends on the good mixing of the mixture and the distribution of the mixture in the moulds, which enhances the texture of the product and gives a good acceptable appearance.

**Penetration measurement:** The penetration test is an important indicator for monitoring the phenomenon of solidification. It is one of the group of tests that studies the changes that occur in the texture, such as hardening and stiffness. The results in Table (4) show significant differences in the means at the level of ( $p < 0.05$ ). The averages of the first day of the standard treatment were all similar, and their value was (17). When the samples were stored for four days at temperature (4), the results showed significant differences in their averages, as it was observed that icing appeared in all samples, so the treatment was A 1.A 2 (16) in which it decreased in the treatment A 3.A 4 if it melted. 15) Or on the eighth day, it was shown that the two treatments A 1.A 2 had the highest averages for resistance to freezing (14), while treatment A 3.A 4 gave the lowest averages (13). On the twelfth day of storing the samples, the treatment had resistance. It gelled significantly, as it gave the highest averages, reaching (13) A 3. A 4 showed gelation significantly, which gave the lowest values (11). It is noted from measuring the gelation of cupcakes and the effect of storage on them that the amount of sugar used did not solve the problem of gelation in the samples, in contrast to the treatment. The standard that shows the least effect on gelation is due to the fact that oat flour is a substance that absorbs moisture in addition to the other substances that were added to the mixture, which greatly affected the samples.

**Turbidity measurement:** Turbidity assay was used to measure starch reflux and the effect of maltodextran addition on this process. The results of the examination, as shown in Table (5), showed a decrease in the average values of turbidity for the cupcake solution with the increase in the storage period of cupcakes (M3, M4, M1, M2) respectively. We conclude from this study that the use of brown sugar led to a noticeable decrease in the amount of protein, while there was an increase in the percentage of protein in the samples of the students and stevia sugar. The use of brown sugar led to an increase in the percentage of carbohydrates, in contrast to the two studies and Stevia sugar treatments, in which the percentage of carbohydrates decreased significantly. The results of the sensory evaluation showed that replacing sugar with stevia led to a lack of acceptance and general acceptance by residents

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