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Utilization of Whole Oat Grains in Cookies Processing for Secondary School Girls in El Mansoura City, El-Dakahlia Egypt

Asmaa S. M. Alsedik; M. T. Shalaby; Rania E. Elgammal* and Alzahraa M. Motawei



Food Industries Department, Faculty of Agriculture, Mansoura University, Egypt.

ABSTRACT

This paper was carried out to study the effect of using whole oat grains in cookies processing for secondary school girls to prevent overweight and obesity. In order to achieve this aim, three formula of cookies A₀, A₁, and A₂ were formulated, rich in dietary fiber, prepared from whole oats grains and wheat flour (WO:WF) with different ratios 100% WF, 50: 50% (WO:WF), 100% WO. Physical, chemical properties and sensory evaluation of prepared cookies mixtures were studied. Results revealed that physical evaluation of cookies samples showed that prevalence rates were increased with the increasing of oats ratio 43.6 to 53.28. There was no significant ($p \geq 0.05$) difference in Overall acceptability between cookies samples. Regarding to the chemical properties of prepared cookies samples, the control cookies sample contains, fiber 0.68 %, protein 11.21% fat 18.92% and carbohydrates 62.38%, and the percentage of fiber increases from 0.68 to 2.64% with increasing ratio of whole oat. Also obtained results found that the calculated calories of prepared cookies decreased with the increase of oats from 426.09 to 421.82 Kcal. Finally, it could be concluded that nutritious and healthy cookies could be prepared by replacing up to 100% wheat flour with whole oats grains without negative effects on the overall acceptability of oat cookies.

Keywords: Cookies, whole oat, physical properties, chemical properties, sensory evaluation.

INTRODUCTION

Recently, there has been an increased demand for foods and beverages, which have been shown to be beneficial or improve health. Thus, baked cookies can serve as an important vehicle for carrying biologically active compounds in the field of functional foods (Mori *et al.*, 2020).

Consumption of high amounts of fat and low amounts of fiber is one of the main nutritional problems we face today, which is associated with an increased incidence of obesity, coronary heart disease, high blood pressure, insulin resistance, gallbladder disease and certain types of cancer – and despite the important role that fats play, there have been continuous efforts to reduce the fat content of food products and replace it with various fat substitutes. Thus, today the demand for foods that are low in fat/calories and those rich in dietary fiber is constantly increasing in the market (Bajpai, *et al.*, 2018).

Cookies are nutritive snacks wheat flour-based produced from unpalatable dough transformed into an appetizing product through the application of heat. (Anozie *et al.*, 2014 ; Ikuomola *et al.*, 2017). It contribute valuable quantities of iron, calcium, protein, calories, fiber, and some of the B-vitamins to our diet and daily food require (Onabanjo and Ighere, 2014; Adeyeye and Akingbala 2015; Abioye *et al.*, 2018).

The major ingredients of cookies are flour, fat, sugar, salt, and water. These are mixed together with other minor ingredients (baking powder, skimmed milk, emulsifiers, and sodium meta-bisulphite) to form dough containing a gluten network. (Onabanjo and Ighere, 2014; Adeyeye *et al.*, 2015; Abioye *et al.*, 2018).

Cookies are an important snacks consumed by all age groups these are most commonly relished by school going children. The growing consumer demands for food with high dietary fiber having good nutritional and sensory quality (Suma and Nandini, 2015).

Oats are increasingly recognized as a super food due to the presence of many health-promoting substances (Ibrahim *et al.*, 2020). Oats (*Avena Sativa L.*) ranks around sixth in the world following wheat, maize, rice, barley and sorghum. They are good source of proteins, fiber and minerals. The amount of oats used for human consumption has increased progressively, the fact health effects of oats benefits mainly on the total dietary fiber and B- glucan content (Ahmad *et al.*, 2014). The bran and germ of oats also contain phytochemicals including tocopherols, tocotrienols, phenolic compounds and plant sterols, thought to have a beneficial effect on health (Gangopadhyay *et al.*, 2015). Oats are rich source of dietary fiber can be considered a high calorie food containing 19 percent more calories than wheat. Oats are also rich in B vitamins, contain the anti-oxidant vitamin E, source of β -glucan and oats are mineral rich as well. Oatmeal is a tonic for general debility, treats anorexia, is good for convalescence and fatigue, lowers blood cholesterol levels and helps to control hormonal activity. Oatmeal cuts the risk of strokes and heart attacks from blocked arteries, stabilizes blood sugar and increases the body's ability to fight off infectious disease (Anwar, 2013 and Pal *et al.*, 2018). The aim of study was using whole oats grains in cookies for secondary school girls to prevent overweight and obesity.

MATERIALS AND METHODS

Wheat flour (72% extraction rate) and whole rolled oats, Sugar, butter, baking powder, eggs and vanillin were



* Corresponding author.
E-mail address: rawana@mans.edu.eg
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procured from local market, EL- Mansoura city, El-Dakahliea, Egypt.

Methods

Preparation of whole oat grains:

Whole oats grains were grinded using a grinder (MOULINEX)

Preparation of cookies:

Cookies were prepared using whole oats and wheat flour with different ratios as mentioned in table (1). Cookies were prepared as described by Bornare and Khan. (2015).

Three different cookies samples were prepared with whole oats and wheat flour at the levels of 0, 50 and 100%. Sugar (25g), fat (25g), egg (10g) and baking powder (1g) were added for all cookies formula.

Table 1. Formulas used in cookies preparation

Ingredients	Cookies samples		
	C	A1	A2
Wheat flour (g)	100	50	--
Rolled oats (g)	--	50	100
Egg (g)	10	10	10
Sugar (g)	25	25	25
Butter (g)	25	25	25
Baking Powder (g)	1	1	1

Control 100% wheat flour - A1 50% wheat +50% oats -A2 100% oats.

All ingredients were weighed accurately, then creaming of butter and sugar was performed, followed by the addition of eggs. The flour and baking powder were added to the creamy mass and mixed to a homogenous mass by mixer (MOULINEX) (N 721 made in France) for 3 min. The cookies were cut using a circular mold with a diameter of 6 cm and a thickness of 1 cm. cookies were baked for 10-15 min at 175 °C in an electric oven (GARBUIO) essiccatoi treviso(made in Italy)

Physical analysis:

Different physical analysis namely (weight, diameter, thickness and spread ratio) were measured for control and prepared cookies sample as follow:

Weight (W): The weight of cookies determined and measured as average of values of six individual cookies with using electronic weighing balance immediately after cooling.

Diameter (D): Six cookies were placed horizontally (edge to edge) and their total diameter was measured with the aid of a ruler and rotated at angles of 90° for duplicate reading.

Thickness (T): The cookies thickness six cookies were placed one above another. The total height of six cookies was measured with help of ruler.

Spread Ratio (SR): The spread ratio is defined as a ratio of diameter and thickness and it was calculated as diameter divided over height ,and it was determined by the formula

$$SR = (Diameter/Thickness \times CF) \times 10$$

Where, CF is a correction factor at constant atmospheric pressure (1.0) in this case(Bornare and Khan, 2015, El-Qatey et al., 2018)

Chemical analysis:

Determination of moisture, protein, fat, crude fiber, ash contents and total carbohydrates content:

Cookies were analyzed for moisture, protein, fat, crude fiber and ash contents according to the methods described in Association of Official Analytical Chemists (AOAC,2007).

Carbohydrate content was calculated from difference, following by equation:

$$CHO\% = 100 - (\% \text{ moisture} + \% \text{ protein} + \% \text{ fat} + \% \text{ ash} + \% \text{ crude fiber})$$

Food energy value (kcal/100 g) was determined according to the method of (Upadhyay et al., 2017)

$$\text{Energy (Kcal)} = (\text{Fat} \times 9) + (\text{Protein} \times 4) + (\text{Carbohydrates} \times 4)$$

Minerals Analyses:

Selected minerals, including iron, calcium, phosphorus, potassium, and sodium were extracted from dry ashed samples and determined using a Pye Unicomp Sp 19000 atomic absorption spectrophotometer (AOAC, 2007).

Sensory Evaluation of cookies:

The sensory evaluation of the processed cookies was carried out by a twenty members consisting of students' secondary school. Describing the quality attributes (color, taste, flavor, texture and overall acceptability) of the cookies was given to each panelist .A score list with 9 points was applied. (Youssef et al., 2016).

RESULTS AND DISCUSSION

Sensory evaluation of cookies produced from wheat flour and whole oats.

Results of the sensory evaluation of cookies produced from wheat flour and oats grains are presented in Table (2). The averages scores of color, taste, flavor, texture, appearance and overall acceptability for the cookies showed that The average scores of cookies, taste, flavor, texture, appearance and general acceptability of cookies showed that the control sample (100% wheat flour) was the first in terms of color, while A2(100%)whole oats it was the lowest. The average degree of color was decreased from 8.65 to 7.95 in (Figure 1) and these results are in accordance to the (Khalil et al.,2015 ,El-Qatey et al.,2018) who reported that the increase in the level of oats affects the color degree. The cookies turn from light brown color to dark brown color, and this leads to a decrease in the degree of acceptance among some consumers, and the dark color may be due to Non-enzymatic reaction of sugar molecules and lysine amino acid (Mallard reaction) and due to caramel (Bertrand et al.,2018). Appearance is one of the important parameters in judging the properties of baked cookies in terms of the raw materials prepared from them, as well as information about formulation and quality of product (Suma and Suma.,2015). In (Figure1) showed that the mean quality score of the appearance of cookies had been decreased from 8.6 to 8.45. Texture is one of the factors that determine the general viability of food by the consumer, as well as the strength of the fraction (El-Qatey et al.,2018). Mean for texture shown in (Figure2) revealed that the sample A2 had highest score (8.6) followed by control sample(8.45) while A1 (8.3) had least score. Observations on texture properties was reported by Stanyon and Costello (1990) that in general , biscuits became less cohesive and more crumbly ,as wheat bran increased, gluten proteins, responsible for the cohesiveness or structure of baked products, were diluted and the formation of gluten became more difficult. Taste is also affected by the quality of the raw materials used for processing cookies (Suma and Suma, 2015). The mean of taste showed that The highest score for taste was obtained by the control sample (8.95) followed by sample A2 (8.8) finally sample A1(8.45) in (Figure2). Flavor is the main criterion for liking a product or disliking it (Suma and Suma, 2015). Mean score for the flavor of the cookies revealed that the control sample had highest score (9.1) followed by sample A2 (8.95) while A1 (8.8) had least score in (Figure2). There were no significant differences (p < 0.05) between the three cookie

samples about the sensory score. These results were nearly (Assis *et al.*, 2009 and El-Qatey *et al.*, 2018) In a study by (El-Zainy *et al.*, 2014) showed that increase Oat flour in biscuits improves the taste, odor and surface appearance, but it has a negative impact on the texture, color and acceptance. Therefore, 100% oat cookies can be considered as acceptable for consumer. Concerning to the data, it could be observed that addition of whole oat have nearly results with those of control sample.

Table 2. Sensory evaluation of cookies produced from wheat flour and whole oats.

Cookies		Sensory characteristics					Overall acceptability
		Color	Appearance	Texture	Taste	Flavor	
Control	100% wheat flour	8.65	8.6	8.45	8.95	9.25	9.1
A ₁	50% wheat +50% oats	8.25	8.5	8.3	8.45	8.8	8.3
A ₂	100% oats	7.95	8.45	8.6	8.8	8.95	8.7
F value		.780	.036	.169	.412	.389	1.307
Sig		.463	.965	.845	.664	.679	.278

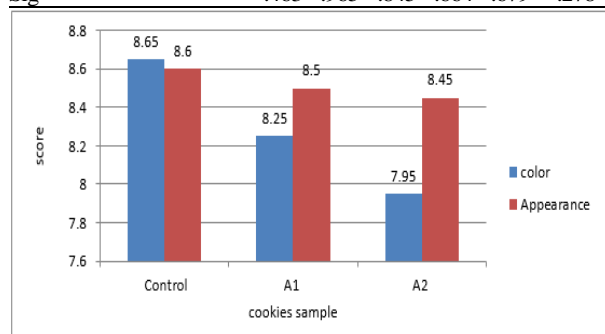


Fig. 1. Average values for color and appearance of cookies

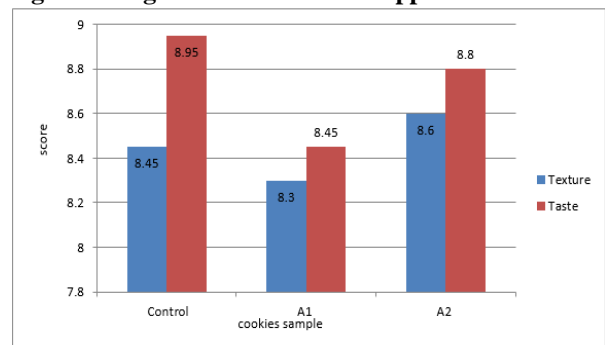


Fig. 2. Average values for texture and taste of cookies

Physical measurements of cookies produced from wheat flour and whole oats.

Results of the physical analysis of the characteristics of cookies produced from wheat flour and oats are depicted in table (3). Which show that the width, thickness and spread ratio was affected by the increase in the level of rolled oats. The data detected that the average weight of cookies ranged between 22.7g to 23.16g. It was noticed that control cookies sample had maximum weight (23.16g). A gradual decrease in weight of cookies was noticed with the addition of oats. These results were in agreement with (Bornare and Khan, 2015)

The diameter of cookies a gradual increase from 6.16 Cm to 6.66 Cm with increasing in the level of whole oat .the result shows that the A₂ sample that its diameter is 6.66 cm was higher than the control sample that its diameter is 6.16. These findings were on the same lines as observed by

(Youssef *et al.*, 2016). On the other hand these results were in disagreement with those of (Raihan and Saini., 2017 and Khalil *et al.*, 2015), who observed that diameter of cookies decreased with increased level of supplementation. Also, the spread ratio increased from 44.6 to 53.28 with increased levels of whole oat. While, cookies thickness a gradual decreased from 1.38 Cm to 1.25 Cm with increasing level of whole oats (Table 3). These results were in agreement with (Khalil *et al.*, 2015). Thus, the results showed that as the level of oats increased in the cookies, there was a gradual decrease in weight and thickness, while increase in the diameter and thus, an increase in the spread rate of the cookies. Findings regarding physical evaluation of cookies are consistent with those (Giram *et al.*, 2017) who reported that gradually increasing the percentage of oatmeal and finger millet resulted in an increase in diameter and spread ratio, and a marked decrease in thickness.

Table 3. Physical evaluation of cookies produced from wheat flour and whole oats.

Cookies sample	Physical evaluation			
	Weight (g)	Diameter (cm)	Thickness (cm)	Spread ratio
Control	23.16	6.16	1.38	44.6
A ₁	23	6.33	1.33	47.59
A ₂	22.7	6.66	1.25	53.28

Control 100% wheat flour A₁ 50% wheat +50% oats A₂ 100% oats.

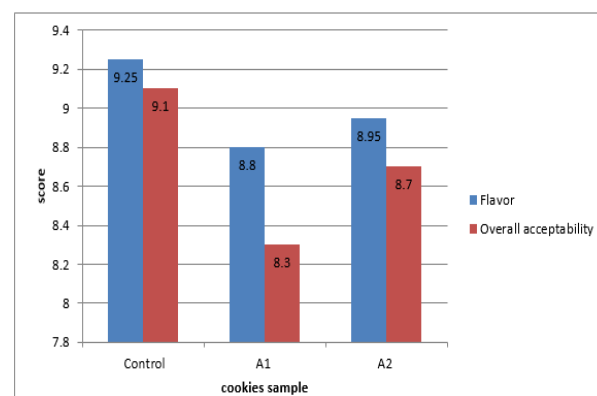


Fig. 3. Average values for flavor and overall acceptability of cookies

Chemical composition of cookies produced from wheat flour and whole oats. (on dry weigh basis).

In present study, two forms of cookies samples (control cookies, (50%, 100% oats) were analyzed for moisture, ash, protein, fat, crude fiber, carbohydrate and energy. All tests analyzed and presented in table (4)

Table 4. Chemical composition of cookies produced from wheat flour (72%) and whole oats (on dry weigh basis).

Cookies samples	Chemical composition						
	Moisture %	Protein%	Fat%	Crude fiber%	Ash%	Carbohydr rates%	Energy (Kcal)
Control	5.92	11.21	18.92	0.68	0.89	62.38	426.09
A ₁	7.20	12.59	20.60	0.94	1.35	57.32	424.99
A ₂	5.70	12.42	21.14	2.64	1.73	56.37	421.82

Control 100% wheat flour A₁ 50% wheat +50% oats A₂ 100% oats.

Results revealed that the moisture content was ranged between 5.7 to 7.2%. sample A₁ (7.20%) is higher than A₂ (5.70%). According to (Ojo *et al.*, 2014)(Abioye *et al.*, 2018)

when moisture content is below than10%, the microbial contamination and chemical reaction decrease therefor, it enhances food quality ,stability and long period storage of food.

Protein content of control sample was 11.21% while the other samples record 12.59 and 12.42% for cookies samples A1 and A2, respectively.

The fat content increased from 18.9% to 20.60% to 21.42% in control sample A₁ and A₂ respectively .this result agree with (El-Qatey et al.,2018)who reported that the fat content increased in oat flour biscuit .

The crude fiber content was ranged between 0.68% to 2.64% .sample A₂ (100% oats) has the highest value of fibers. This may be due to oats is a good source of fiber (Youssef, et al., 2016). This result was similar to (Raihan and Saini .,2017) who reported that the fiber content varied from 0.89 to 1.96%.for cookies prepared from oats flour, sorghum, amaranth and wheat flour

The ash content of prepared cookies ranged between 0.89% to 1.73%, and the ash content increased by increasing the level of oatmeal in the cookies. The highest ash content is an indicator of mineral constituents present in the sample (Ikuomola et al., 2017).

The carbohydrates content of cookies ranged from 56.37% to 62.38%. Because of the increase of oats in cookies, the content of carbohydrates decreased to 56% as compared to the control sample with 62.3%. These results agree with (Shrestha, 2019).

The energy value in control sample was 426.09%, but the other samples were (424.99%and 421.82%) in samples A₁ and A₂ respectively. It noticed that the A₂ sample had the lowest value of energy and this decrease because of the increase of the level of oats, on the other hand the control sample has the highest value of energy. According by (Chauha et al., 2018), There was decrease in calorific value of bread with increasing the level of oat flour.

The constituents of the medley that contain fat, protein and carbohydrate participated in the energy value of the cookies.

All ages can consume these cookies between meals because they are energy-saving foods.

Some minerals content of cookies produced from wheat flour and whole oats:

Table (5) showed the mineral composition of cookies product from wheat flour and whole oats. The results reveal that, the value of Iron ranged from 0.016% to 0.023%, while the value of calcium ranged between 0.03% to 0.04%. The results also show that the value of Sodium in the cookies ranged between 0.21 % to 0.29%, while the value of Phosphorus ranged from 0.29% to 0.47% finally, the value of potassium ranged from 0.13% to 0.26%. Results indicated that content of minerals in cookies increased. This increase may be due to the high mineral content in oat flour such as phosphorous, potassium, calcium, iron, etc., as mentioned by (Youssef et al., 2016).

Table 5. Some minerals content of cookies produced from wheat flour and whole oats:

Cookies Samples	Minerals content %				
	Fe	Ca	Na	K	P
Control	.016	.03	.21	.13	.29
A ₁	.021	.04	.25	.19	.47
A ₂	.023	.04	.29	.26	.35

Control 100% wheat flour A₁ 50% wheat +50% oats A₂ 100% oats.

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استخدام حبوب الشوفان الكاملة في تحضير الكوكيز لطالبات المرحلة الثانوية بمدينة المنصورة، الدقهلية، مصر أسماء سعد محمد الصديق، محمد طه شلبي، رانيا إبراهيم الجمال و الزهراء محمود مطاوع، قسم الصناعات الغذائية، كلية الزراعة، جامعه المنصورة

أجرى هذا البحث لدراسة تأثير استخدام حبوب الشوفان الكاملة في تحضير الكوكيز لطالبات المرحلة الثانوية للوقاية من زيادة الوزن والسمنة. تم تحضير ثلاث عينات من الكوكيز A1 و A2 و C، تم تحضيرها من الشوفان الكامل الغني بالألياف والدقيق بنسب مختلفة 100% دقيق، 50% شوفان كامل: 50% دقيق، 100% دقيق شوفان كامل. تمت دراسة الخصائص الفيزيائية والكيميائية والتقييم الحسي للكوكيز المصنع، وأظهرت النتائج أن الصفات الفيزيائية للكوكيز يزيد من معدل الانتشار 43.6 إلى 53.28 مع زيادة حبوب الشوفان كامله. وأظهرت نتائج الصفات الحسية أنه لا توجد فروق معنوية بين قيم القبول العام لعينات الكوكيز المحضرة. فيما يتعلق بالصفات الكيميائية لعينات الكوكيز، أظهرت نتائج الاختبارات التحليلات الكيميائية أن العينة الكنترول من الكوكيز تحتوي على ألياف 0.68%، بروتين 11.21%، دهون 18.92%، كربوهيدرات 62.38%، وزادت نسبة الألياف 0.68: 2.64% مع زيادة نسبة الشوفان الكامل، ووجد أن السرعات الحرارية في عينات الكوكيز انخفضت مع زيادة نسبة الشوفان 426.09 إلى 421.82 كيلو كالوري. أخيرًا، يمكن استنتاج أنه يمكن تحضير كوكيز مغذي وصحي عن طريق استبدال نسبه تصل الى 100% من دقيق القمح بحبوب الشوفان الكامل دون أي آثار سلبية على القبول العام للمستهلك للكوكيز المصنع.

الكلمات المفتاحية: الكوكيز، حبوب الشوفان الكاملة، الخواص الفيزيائية، الخواص الكيميائية، التقييم الحسي.