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Evaluation of the effect of replacing wheat flour with different percentages of pumpkin flour and agaricus bisporus flour on the physico-chemical and organoleptic properties of functional cookies

Sami Khudhur Saeed[1], Mohammed Jasim Mohammed[1], Shahad Khalid Hameed[2]

[1]Department of food science, college of Agriculture, University of Tikrit, Tikrit, Iraq
[2]Department of Home Economics, College of Education for Women, University of Tikrit, Tikrit, Iraq

Email: samialobaidi@tu.edu.iq

Abstract: ***This study was conducted using mushroom flour and pumpkin flour in cookies to improve and enhance nutritional value and to assess acceptability. The cookies were prepared by replacing wheat flour with 10 and 20% flour from Agaricus bisporus flour and the same percentages from pumpkin fruit flour. The chemical composition of the raw materials was analyzed and it was found that mushroom flour and pumpkin fruit flour contained higher percentages of protein, fat, ash and fiber compared to what wheat flour contained. The cookies were also analyzed in terms of physical properties, chemical composition and organoleptic properties. Where the results showed a rise in the diffusion of cookies with an rise in the substitution rates of mushroom flour and pumpkin flour, and the highest value was at the 20% replacement rate, and it was at 6.92 and 6.56 for mushroom and pumpkin, respectively. With the increase in the concentration of mushroom and pumpkin flour, there was an increase in the content of protein, ash and crude fiber. The crude protein content of cookies with 20% mushroom pumpkin flour and flour was the highest. Also, the cookies with mushroom and pumpkin flour added have an acceptable sensory quality, up to a ratio of 7.4 .***

Keywords: functional cookies, Agaricus Bisporus, pumpkin flour, chemical composition.

1. INTRODUCTION

In recent times, the commercial position of functional foodstuffs has grown-up significantly, as consumers turning to these produces (Romero-Lopez et al., 2011). Thus, the relation among health and nutrition is becoming stronger, and the improvement of novel functional foods including constituents advantageous to health is rising (Mesías et al., 2016). Bread, biscuits, cookies and cakes are among the popular bakery products, which are consumed by all age groups due to the long shelf life of these products in addition to the variety of consumer tastes and their low cost (Salehi, 2019). Cookies are a type of baked food that is characterized by high flour, sugar and margarine content and low moisture content (Xu et al., 2020). Usually a snack, nutritious and quick, produced from a range of recipes, cookies

are also very popular and provide a way to enhance the nutritional enrichment of populations in developing countries (Rao et al., 2018). Cookies are usually produced from wheat and part of the wheat can also be replaced with other starchy sources, and based on consumer acceptance, different levels of success have been recorded with the use of flour from the fruits of some vegetable sources such as legumes, roots and grains in bakery products (Farheena et al., 2015). Dried mushroom is one of the sources that have great potential to support and enhance the health of the organism (Bello et al., 2017). powder of mushroom has excellent potential to be utilized as an ingredient in different food industries, for instance bakeries and breakfast cereals, bread, cakes and biscuits (Farzana and Mohajan, 2015). Powder of mushroom can be utilized in produces of bakery to acquire valued products and nutrients that can be expended via a varied range of consumers including nearly all meal (Salehi, 2019). A pumpkin is a nutritious food luxuriant with minerals and vitamins, on the other hand calories is low . Pumpkin includes beta-carotene, which has a height percentage of antioxidants (Fathonah et al., 2020). Rismaya et al., (2018) found that yellow pumpkin is valuable in minerals, β-carotene, vitamins with fiber, and an excellent hard work have been prepared to utilize yellow squash by converting fresh yellow pumpkin into pumpkin flour and using it as a substitute for wheat flour used in the manufacture of bakery products such as cookies and cakes. Yellow pumpkin flour can be classified as an elevated -fiber food as the smallest dietary fiber content should be 6g/100g (Foschia et al., 2013). Purnamasari and Putri, (2015) reported that the whole fiber content of pumpkin flour was 14.81%, while also another studies, the whole fiber content of pumpkin flour was greater, reaching 21.39-21.41%.

2. MATERIALS AND METHODS

2.1.Materials

Fresh mushroom (Agaricus bisporus), fresh yellow pumpkin fruits, wheat flour and additional components of the cookie mixture for example baking powder, cornstarch, sugar flour and margarine were gotten from the local marketplace in Tikrit.

2.2.Preparation of mushroom and pumpkin flour

The fruits of mushroom and pumpkin were washed extremely by flowing water to take away impurities, dirt and dust, later they were cut into slices with a thickness of 5 mm, and then these slices were dried by a drying device at a temperature of 65 °C for 9-10 hours for mushroom slices and 7-8 hours for pumpkin slices. Awaiting to reaching a moistness content of 5-6%, then the dry slices were ground using an electric grinder into flour and saved in bags of polyethylene sealed until utilize.

2.3.Cookies preparation

The cookies were prepared as the method utilized by (Fathonah et al., 2020), where wheat flour was substituted with various extents of pumpkin complete flour in extents of 10 and 20% and flour of mushroom 10 and 20%. The components of the cookie mixture were elucidated in Table1. The margarine was admixed with sugar as powdered utilizing a mixer for 5 minutes up until a good quality cream was established, next the yolk of egg was added to the cream. Add the flour of wheat with the residue of the components to the cream and mix in the mixer until the dough formulae good and is ready to slicing and spreading. Put the shaped pieces of dough in the oven at 150 °C for about 18 minutes. Then, the cookies were taken out of the oven and put to down of cool until reach temperature of room, and they were packed in bags of sealed polyethylene for utilizing.

Figure 1: shows the forms of cookies produced by replacing mushroom and pumpkin flour with proportions of 10 and 20%.

Table 1: Ingredients for mushroom and pumpkin cookies

Ingredients	Treatments ratios and quantities				
	T1	T2	T3	T4	T5
Wheat flour	450 gm	400 gm	350 gm	400 gm	350 gm
mushroom flour	0	50 gm	100 gm	0	0
pumpkin flour	0	0	0	50 gm	100 gm
Corn Starch	50 gm	50 gm	50 gm	50 gm	50 gm
margarine	350gm	350gm	350gm	350gm	350gm
Crushed sugar	180gm	180gm	180gm	180gm	180gm
yolk	32gm	32gm	32gm	32gm	32gm
Baking powder	5gm	5gm	5gm	5gm	5gm

Where the treatments symbols represent the following:

T1: Cookies made with 100% wheat flour.
T2: Cookies made with 90% wheat flour and 10% mushroom flour.
T3: Cookies made with 80% wheat flour and 20% mushroom flour.
T4: Cookies made with 90% wheat flour and 10% pumpkin flour.
T5: Cookies made with 80% wheat flour and 20% pumpkin flour.

2.3.Physical properties

The physical properties of the cookies such as diffusion, thickness, diameter and were determined as illustrated below (Noor Aziah et al., 2012). The ratio of diffusion was calculated by obtaining the ratio of diameter to thickness. Ten cookies were unsystematically

a selection of from every sample and analyzed. Thickness (T), Diameter (D), and ratio of diffusivity as physical properties of cookies were analyzed by using RFF. To determine the cookie cutter diameter (D), six cookies were placed edge-to-edge. The whole diameter of the six unsystematically chosen cookie cutters was determined utilizing a ruler. The average diameter was measured in centimeters. To measure the thickness (T), six cookies are put on top of each other. The whole height was determined with the assistance of a ruler. This measurement was repeated three times to take the value of average and the results were calculated in centimeters. As for the diffusion rate, it was estimated utilizing the following equation:

$$\textbf{Diffusion rate} = \frac{\textbf{diameter } (cm)}{\textbf{thickness (cm)}}$$

2.4.Chemical components of raw materials and cookies

The fat, moisture, ash, and fibers content were assessed utilizing methods of AOAC (2000). The protein content was assessed by method of Kjeldahl (6.25 N) and whole carbohydrates were estimated by variance.

2.5.Organoleptic properties of cookies

The models were sensorial evaluated by ten specialists from the Department of Food Sciences - College of Agriculture - Tikrit University. A 9-point scale rating test was used. Sensory factors for example texture, taste, colour and general acceptability were estimated (Ranganna, 2000).

2.6.Statistical Analysis

By utilizing the Linear Model General with the ready-made statistical program (SAS, 2001) the results of the experiments were studied for examine the influence of factors on the complete random design (CRD). Duncan's test (Duncan, 1955) was as well conducted to limit the significance of the variances between the means of the factors have an effect on the considered traits on the level ($p<0.05$).

3. RESULTS AND DISCUSSION

3.1.Chemical composition of raw materials

The chemical composition of the raw materials wheat flour, mushroom flour and pumpkin flour has been clarified in Table 2. where the results indicated a significant rise at $P< 0.05$ in the protein for mushroom flour, which was at 29.7% compared to wheat flour and pumpkin flour, which was at 14.1 and 11.4%, respectively. As for fat, there was a significant increase in mushroom flour and pumpkin flour, and its percentage was at 1.8 and 1.5%, respectively, compared to the percentage of fat in wheat flour and it was at 0.86%. From the table we also notice the significant increase in the ash percentage of mushroom flour and pumpkin flour, and it was 7.9 and 7.5%, respectively, compared to the ash percentage of wheat flour, which was at 0.3%. On the other hand, a significant decrease was found in the percentage of carbohydrates, where the highest percentage was for wheat flour and it was at 73.64%. When estimating the fiber, a significant increase was observed for mushroom and pumpkin flour, which were at 8.3 and 5.8%, respectively, compared to the percentage of fiber in wheat flour, which was 0.6%. The results agreed with Kanwal et al., (2015) who assessed ash ,moisture, fat, protein, and cookie fiber complemented with 20% pumpkin flour, as (4.76, 9.20, 20.39, 1.68, 3.40 and 1.55%), respectively. The results in the same table showed that the percentage of total dietary fiber was the highest in mushroom powder and pumpkin powder, and the

lowest in wheat flour with an extraction rate of 72%, as the increase in the proportion of replacement led to an increase in the proportion of fiber (Nyam et al., 2009).

Table2:Chemical composition of raw materials wheat flour, mushroom flour and pumpkin fruit flour

Treatments	Moisture	Protein	Fats	Ash	Fiber	Carbohydrate
	%					
Wheat flour	10.5+0.57a	14.1+0.057b	0.86+0.057c	0.30+0.005b	0.6+0.05c	73.64+0.057a
Mushroom flour	5.9+0.057b	29.7+0.03a	1.8+0.057a	7.9+0.057a	8.3+0.577a	46.4+0.057c
Pumpkin flour	6+0.057b	11.4+0.057c	1.5+0.057b	7.2+0.057a	5.8+0.057b	68.1+0.057b

***Similar letters in the similar column mean that there are no significant variances between them at the 0.05 . probability level.**

Dietary fiber has many properties such as water retention, oil retention, emulsification, and gel formation; It can also be used in food products (Elluech et al., 2011). Enhancing food products with dietary fiber to help modify the structural properties of food, as well as to stabilize high-fat and emulsified food items. Total dietary fiber is an important component of the daily diet, while total dietary fiber intake and its fractions provide beneficial health effects for consumers (Slavin, 2005).

3.2.Physical properties of cookies made by replacing wheat flour with mushroom and pumpkin flour

Table 3 shows the effect of replacement ratios of wheat flour with Agaricus bisporus flour and pumpkin fruit flour on the physical properties of cookies. Whereas, the replacement with mushroom flour with proportions of 10 and 20% caused a significant increase in the diameter and were at 6.17 and 6.3 cm, respectively, compared with wheat flour, which had a diameter of cookies at 6 cm, while pumpkin flour with replacement rates of 10 and 20% did not cause any significant differences. at 5.96 and 5.91 cm. The results showed that the diffusion rate increases with the increase in the percentage of replacement for both mushroom flour and pumpkin fruit flour, and there was a significant increase in it and it was at 6.56, 6.92, 6.4 and 6.49 for each of the mushrooms 10%, the mushrooms 20%, the pumpkin 10% and the pumpkin 20%, respectively. Compared with the control treatment (100% wheat flour), which had a diffusion rate of 6.31. Diffusion rate is an important factor affecting biscuit quality parameters, ie texture, and overall mouth feel (Jothi et al., 2014). The diffusion rate of improved biscuits reached from 12.14 to 14.79 Biscuits containing 60% wheat flour in addition to 40% pumpkin flour indicated the maximum rate of diffusion, while the control treatment indicated the lowermost rate of diffusion. It can be seen that the diffusion of biscuits fortified with pumpkin flour was significantly increased ($P < 0.05$) by rising the percentage of replacement. And the variances in the properties of baking for the improved

biscuits can be due to variances in the quantity and quality of protein in the dough; It may too be connected to the capability of the dough to retain gas through the process of baking (Ramadan et al., 2010).Biscuits containing pumpkin flour indicated upper rate of diffusion, lesser thickness and diameter than the control sample. Noor Aziah et al., ((2012) reported that the establishment of the gluten network is affected by the content of protein in the dough which rises viscosity and decreases flow of dough ,therefore, rising thickness and diameter.

Table 3: Effect of replacement ratios on the physical properties of cookies

Treatments	Diameter (cm)	Thickness (cm)	Diffusion rate
T1	**6.0 + 0.057 b**	**0.95 + 0.005 a**	**6.31 + 0.005 d**
T2	**6.17 + 0.05 a**	**0.94 + 0.005 ab**	**6.56 + 0.05 b**
T3	**6.3 + 0.057 a**	**0.91 + 0.005 c**	**6.92 + 0.005 a**
T4	**5.96 + 0.005 b**	**0.93 + 0.005 b**	**6.4 + 0.057 cd**
T5	**5.91 + 0.005 b**	**0.91 + 0.005 c**	**6.49 + 0.005 bc**

*** Similar letters in the similar column mean that there are no significant variances between them at the 0.05 probability level.**

3.3.Chemical composition of cookies

The chemical composition of the industrial cookies was evaluated by substituting flour of wheat with mushroom and pumpkin flour in proportions of 10 and 20%, as in Table (4), where there was a significant reduce in the level of moisture in comparison between the control sample and treatments, where the moisture was at 3.95% for the control, which is the highest value. While there was a significant rise at $P< 0.05$ for ash, fiber and protein. The protein risen significantly with an rise in the substitution rates, as its percentage was at 11.3, 15.47 and 10.5% for mushroom 10%, mushroom 20% and pumpkin 20%, individually, compared to the control treatment (wheat flour) in which the percentage of protein was at 8.92% while pumpkin flour was 10 % did not lead to a significant variance with the control treatment and it was at 8.5%. Regarding to ash, its percentage risen significantly with an rise in the substitute ratios of mushroom flour 10%, mushroom 20%, pumpkin flour 10% and pumpkin 20%, and it was at 2.6, 3.47, 1.8 and 2.8%, individually, compared to the control treatment in which the ash percentage was at 0.53%. The fibers too seen a significant rise in the percentage of ash with the rise in the substitute rates and it was at 1.6, 2.56, 1.1 and 1.8% for mushrooms 10%, mushrooms 20%, pumpkin 10% and pumpkin 20% individually compared to the control sample in which the percentage of fibers was 0.89% . As for the carbohydrates, the pumpkin treatment had the highest percentage of 10% and was at 68.9%, followed by the control treatment in which the percentage of carbohydrates was at 68.4%. After that, the carbohydrate content was decreased in the rest of the treatments. These results approved with what was establish by Rathore et al., (2019), as it was found that the highest carbohydrate content was in the control treatment and then reduced more significantly in the rest of the treatments. The reduction in carbohydrates could be because of decreased levels of refined flour of wheat, which has been replaced by mushroom powder (Farzana and Mohajan, (2015). While the percentage of fat did not have any significant differences except for the pumpkin treatment 20%, in which the percentage of fat was at 18.6% compared with the control treatment and the rest of the treatments. Perhaps the reason for the rise in the fiber

and protein content of cookies by rising the percentage of replacement with mushroom flour

Treatments	Moisture	Protein	Fats	Ash	Fiber	Carbohydrate
	%					
T1	3.95+0.028a	8.92+0.005c	17.31+0.057b	0.53+0.057d	0.89±0.005d	68.4+0.057a
T2	2.8+0.057c	11.3+0.057b	17.5+0.057b	2.6+0.057b	1.6±0.057b	64.2+0.057b
T3	3.35+0.005b	15.47+0.005a	17.39+0.005b	3.47+0.005a	2.56+0.057a	57.76+0.057d
T4	2.4+0.057d	8.5+0.057c	17.3+0.057b	1.8+0.057c	1.1+0.057c	68.9+0.057a
T5	2.9+0.057c	10.5+0.28bc	18.6+0.05a	2.8+0.057b	1.8+0.057b	63.4+0.057c

or powder is that this mushroom is mainly famous for its richness in proteins and fiber, which contributed to the increase in its content of these elements. These results also agreed with what was found by Dhalagade et al., (2020), who reported that the content of cookies gradually increased for protein (5.2-10.15%) and ash (0.30-0.98%) with increasing mushroom flour or powder. These results also agreed with the studies conducted by (Salehi et al., 2016; Ng et al., 2017) who confirmed that the increase in

protein and ash content with an increase in the proportion of mushroom flour or powder replaced in cookies.

Table 4: Chemical composition of Functional Cookies

*** Similar letters in the similar column mean that there are no significant variances between them at the 0.05 probability level.**

3.4.organoleptic properties of cookies

Table 5 indications the results of the sensory assessment of the samples of cookies that replaced wheat flour with Agaricus bisporus and pumpkin flour, at percentages of 10 and 20% for each of them, and at a significant level of $P< 0.05$, where the control treatment of 100% wheat flour obtained the highest values for both color and taste, texture and general acceptance were at 8.9, 8.8, 8.6 and 8.8, respectively. Regarding the color, there were no significant differences for the treatments mushroom 10%, pumpkin 10% and pumpkin 20% and their values were at 8, 8.2 and 8.1 respectively compared to the control treatment (100% wheat flour), which got the highest value at 8.9. We note that the value of Acceptance of color decreases with the increase in the percentage of replacement, and that the lowest value of mushrooms with a replacement rate of 20% and was at (7.6). we notice from the table that the taste had a significant decrease, as the control treatment got the highest value, which was at 8.8, while the treatments for mushrooms 10%, mushrooms 20%, pumpkin 10% and pumpkin 20%, their values were at 7.7, 7.8, 8.4 and 8.1, respectively. The texture also got the highest value in the control treatment and it was at 8.6, while the rest of the treatments we notice that there are significant differences at $P< 0.05$, where mushrooms 10 and 20% had the lowest value at 7.9 and 7.6, respectively, while the cookies made of pumpkin with replacement rates of 10 and 20% More than mushroom cookies

Table 5: organoleptic evaluation of cookies.

Treatments	Color	Taste	Texture	Overall Acceptability
T1	8.9 ± 0.1 a	8.8 ± 0.13 a	8.6 ± 0.16 a	8.8 ± 0.13 a
T2	8.0 ± 0.14 b	7.7 ± 0.26 b	7.9 ± 0.29 b	7.8 ± 0.3 b
T3	7.6 ± 0.3 c	7.8 ± 0.33 b	7.6 ± 0.3 b	7.4 ± 0.3 bc
T4	8.2 ± 0.2 b	8.4 ± 0.31 ab	8 ± 0.25 ab	8.4 ± 0.2 ab
T5	8.1 ± 0.23 b	8.1 ± 0.22 ab	8.2 ± 0.29 ab	8.1 ± 0.23 ab

*** Similar letters in the similar column mean that there are no significant variances between them at the 0.05 probability level.**

The results also showed that the general acceptance had a significant decrease compared to the control treatment, which was the most acceptable at 8.8, followed by the pumpkin 10% treatment, which was 8.4, after the pumpkin 20% treatment at 8.1, while the mushroom cookies 10 and 20% were the lowest general acceptance and it was at 7.8 and 7.4, respectively.

These results are in agreement with that of Dhalagade et al., (2020) where overall capability scores indicated a reduce in general capability with an rise in the substitute ratio of mushroom powder flour. Taste and general capability are the main factor affecting market acceptance of the sample. The overall taste and capability score were found to reduce also, with the maximum score obtained in the control group and the lowermost score in C5 in general acceptability. Also, the previous results of Kumar et al., (2019) indicated a negative relationship between total capability and raised levels of mushroom adding in congruence with our findings. From this sensory assessment, we suggest that the partial substitute of refined wheat flour with powder of mushroom to develop its nutritional value in acceptable sensory levels.

4. CONCLUSIONS

The use of mushroom and pumpkin flour led to an increase in the protein, fiber and ash content of the cookies, because it is one of the important sources of these elements. The use of mushroom flour also had an effect on the spread of cookies after baking, where the highest percentage was when using mushroom flour by 20%, and the results of the sensory evaluation showed and the general acceptance of a relative decrease in the degree of acceptance of cookies, especially when using mushroom flour with a replacement rate of 20%, where the resulting cookies appeared in a dark and dusky color. This product also got the lowest degree of acceptance, but it was acceptable. Functional cookies can be manufactured with higher percentages than the percentages used from mushrooms and pumpkin, and a study and evaluation of the effectiveness of this product on the immune and health factors of laboratory animals due to the richness of mushrooms and pumpkin in active substances and antioxidants.

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