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Development of Gluten Free Biscuit with A combination of Sweet Potato, Yellow Lentil and Safflower Flours

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Abstract

The free gluten biscuits are designed for those who have celiac disease, often known as gluten intolerance. The production of gluten-free goods can be done in two different methods: either by isolating the gluten from the grain or, in the case of bakery and pastry products, by substituting other forms of gluten-free flour for the grain flour. In this experiment, the flours used to make the gluten-free biscuits were safflower, yellow lentil, and sweet potato. By adjusting the ratio of the flours, four experimental versions—gluten-free biscuits—were produced. These varieties were designated A, B, C, and D. Different flour samples' estimated chemical composition and physical characteristics revealed an improvement in the physical characteristics relative to the control and an increase in the chemical components (wheat flour). By increasing safflower seed flour to 30% (D biscuit), the chemical makeup of free gluten biscuit and the amounts of the elements Zn, K, Fe, and Mg greatly increased ($p<0.05$). According to statistical analysis, there was no discernible difference among the control and other gluten-free biscuit samples for the physical characteristics weight, volume, specific volume, thickness, and spread ratio. We concluded that, the sensory quality of free gluten biscuits can be unaffected by the addition of up to 30% safflower seed flour, 50% sweet potato flour, and 20% yellow lentil flour.

Keywords: Sweet potato, yellow lentil, safflower and free gluten biscuit

1. Introduction

A chronic condition of the small intestine known as celiac disease or gluten sensitive enteropathy is brought on by gluten exposure in people with a hereditary predisposition. Chains of amino acid sequences present in the prolamin parts of wheat, barley, and rye trigger a potent immunological response, which is one of its distinguishing features [1]**.** The main form of treatment is a lifetime gluten-free diet. It is difficult to offer CD patients a selection of wholesome and nutritional bakery goods [2].

Although it is an important energy and carotenoids factor in the human diet, yellow sweet potatoes are primarily grown by small farmers and are a very perishable crop. Yellow sweet potato powder has been created to broaden its industrial applicability for usage in baking goods [3]. Sweet potatoes are abundant in fibre, vitamins, minerals, protein, and carbohydrates [4]. Additionally, it contains bioactive phytochemicals including polyphenols that have anti-inflammatory and anticancer properties [5,6]. The human diet should include legumes since they are a quite source of protein, vitamins, minerals, dietary fiber, and bioactive substances [7] Legumes have been shown in numerous studies to have positive health effects, including a decreased risk of coronary heart disease, colon cancer, diabetes mellitus, hypertension, and gastrointestinal diseases. One of the most widely grown leguminous food crops, the lentil had a global production of roughly 6 million tons in 2019 [8]. Greater protein, fiber, iron, and vitamin B content, particularly folate (B9), which was discovered to be two times higher in lentils than in rice, are some of their distinguishing qualities. Prebiotics make up a portion of their substantial carbohydrate content, and their resistant starch composition may lower the glycemic index of foods [9,10]**.**

Safflower (Carthamus tinctorius L.) is also known as honghua (red flower) in China, khortom in Egypt, and kusum in India and Pakistan. It is an oil seed crop with a linoleic and oleic acid content of roughly 80% [11]. The protein content ranged from 14.70% to 16.21%, crude fibre from 21.34% to 22.51%, total lipid from 32.47% to 35.12%, nitrogen free extract from 22.47% to 26.11%, and

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ash from 3.45% to 4.21%. The moisture content was from 5.24% to 6.23%. (on wet weight basis). According to amino acid tests, it contains a greater quantity of arginine, 3.94 to 5.28 g/100 g. Defatted safflower meal contained a total of 452.52 mg to 677.27 mg of polyphenols (GAE/100g) [12] .

Due to the variety of flavors, long shelf life and low price, biscuits are the most popular foods among children and adults. Result of marketing competition and an increase in consumers' need for natural products that are less harmful than industrial and useful ones, many attempts are composed of modify the chemical composition of biscuits to increase its nutritional value and functionality. When working to boost the protein and mineral content of biscuits for quality and availability, these benefits are frequently achieved by increasing the amount of raw materials other than wheat or various types of dietary fibre in basic recipes [13, 14]. The aim of these studies was to create gluten-free biscuits that were comparable to wheat flour in terms of quality and nutritional content by substituting sweet potato flour, yellow lentil seed flour, and safflower seed flour for wheat flour.

2. Materials and Methods

2.1. Materials:

Wheat flour (72%), yellow lentil, safflower seed and sweet potato with other raw materials (shortening, sucrose, leaving agent, eggs and vanilla powder) were sold from local market in Tanta City, Gharbiya Governorate, Egypt

2.2. Methods:

2.2.1. Preparation of raw materials

Sweet potatoes were cleaned in tap water, manually peeled, chopped into 1 cm pieces, spread out equally on several trays, and dried in an electric drying oven (UNOX, XBC605, Made in Italy) at 60°C/12 hours [15]. To generate uniformly sized flour, the dried samples of sweet potato, yellow lentils, and safflower seeds were ground into flour using a laboratory grinder (Model Moulinex type, No Y45, made in Spain). After that, the flour was placed in a sealed plastic bag and kept at room temperature (25 ^{o}C) until it was needed.

Figure (1): Flour samples A= Sweet potato flour, B= Yellow lentil flour and C= Safflower seed flour

2.2.1.1. Proximate analysis of flour samples

Flour samples were analyzed for moisture, protein, ash, fat and crude fiber according to the methods of [16]**.** Total carbohydrate was calculated by difference as following: Total carbohydrate= 100– (protein+ Fat+ Ash+fiber).

2.2.1.2. Functional Properties of flour samples:

2.2.1.2.1. Water absorption capacity

The flour samples' capacity to absorb water was evaluated using the **Beuchat** [17] method. In a centrifuge tube, one gramme of the flour was combined with 10 ml of water and let to stand for one hour at room temperature (30 2°C). It was then centrifuged for 30 minutes at 2000 rpm. Water on the sediment was measured in terms of volume. In terms of millilitres of water absorbed per gramme of flour, water absorption capabilities were estimated.

2.2.1.2.2. Bulk density

The **Wang and Kinsella** [18] technique was used to calculate bulk density. In a graduated measuring cylinder with a 50 ml capacity, 10 grammes of sample were weighed. By lightly tapping the measuring cylinder on the bench top, the sample was packed. It was noted how much of the sample there was.

$$Bulk\ density\ g/ml = \frac{weight\ of sample}{Volume\ of\ sample}$$

2.2.1.2.3 Dispersibility

Using the procedure outlined by [19] dispersibility was assessed. In a 100 ml measuring cylinder, 10 grammes of flour were suspended, and 100 ml of distilled water was then added. The setup was given a thorough stir before being let three hours to settle. The amount of settled debris was measured and subtracted from one hundred. A dispersibility percentage was used to report the difference.

2.2.2. Preparation of free gluten biscuits and wheat flour biscuit as a control

Sweet biscuit was prepared by whole replacing the wheat flour with mixture of sweet potato flour, yellow lentil flour and safflower seed powder. Biscuits formula were according to method described by [2]

Table (1)
Ingredients of free gluten biscuit and wheat flour biscuit as a control

Ingredients, g	A	B	C	D
wheat flour	100	-	-	-
Sweet potato flour	-	70	60	50
Yellow lentil flour	-	20	20	20

Safflower seed flour	-	**10**	**20**	**30**
Shortening	**28**	**28**	**28**	**28**
Sugar	**35**	**35**	**35**	**35**
Eggs	**27.5**	**27.5**	**27.5**	**27.5**
Vanilla	**1**	**1**	**1**	**1**
Baking powder	**3**	**3**	**3**	**3**

2.2.2.1. **Proximate analysis of free gluten biscuits and control**

According to the procedures of [16], biscuits were examined for moisture, protein, ash, fat, and crude fibre. By using the differential, total carbohydrate was computed. The following formula from [20] was used to determine total calories: Total calories = Fat x 9 + Protein x 4 + Total carbohydrate x 4

2.2.2.2. **Determination of minerals of free gluten biscuits and control**

Minerals were measured using dry ashing at 430–600 ºC in accordance with the **AOAC** [16] technique. Each mineral was then individually dissolved in 1 ml of 10% HCL solution, and the volume was completed to 100 ml with distilled water. Magnesium, calcium, zinc, and iron were quantified using a Shimadzu model atomic absorption spectrophotometer, while sodium and potassium were tested using flam photometry (AA-6650).

2.2.2.3. Physical Characteristics of free gluten biscuits and control

As indicated by [21], biscuits were assessed for weight (g), capacity cm3, specific volume cm3/g, thickness (mm), diameter (mm), and spread ratio. For the evaluation, six biscuits were placed edge to edge, and the average was recorded. A Vernier Caliper was used to measure the diameter and thickness. The following calculation was used to get the spread ratio from the diameter to thickness ratio: Spread ratio = Diameter / Thickness.

2.2.2.4. **Hardness of Biscuits**

According to [22] the hardness of biscuits was assessed using a Texture Profile Analyzer (TPA). A universal testing device was used to determine the hardness of the biscuits (Brookfield Engineering Lab. Inc., Middleboro, MA 02346- 1031, USA). In a TPA, a cylindrical probe with a 25 mm diameter was employed at a speed of 2 mm/s. The TPA graphic was used to calculate hardness in Newton (N).

2.2.2.5. Sensory evaluation:

Ten panellists from the Food Science and Technology Department, Faculty of Home Economics, Al Azher University, Tanta, evaluated the organoleptic properties of biscuit samples (appearance, colour, odour, texture, taste, and overall acceptability) using the methodology outlined by [23].

2.2.3 Statistical analysis

SPSS 20 was used to evaluate the analytical data. Descriptive statistics were used to compute means and standard deviations. Analysis was used to assess how samples compared to one another.

3. Results and discussion:

3.1. Chemical composition of wheat, sweet potato, lentil and safflower seed flour

The proximate compositions of raw materials (wheat flour 72%, sweet potato flour, lentil flour and safflower seed flour) were presented in Table 2. The raw materials showed significant differences in values ($p < 0.05$) of moisture, protein, fat, ash, crude fiber and carbohydrate contents.

Table (2)
Chemical composition of wheat, sweet potato, lentil and safflower seed flours

Components	**Wheat flour**	**Sweet potato flour**	**Lentil flour**	**Safflower seed flour**
Moisture,%	9.53 ± 0.24^{a}	$8.92\pm.040^{b}$	9.26 ± 0.16^{ab}	6.74 ± 0.15^{c}
Protein ,%	9.89 ± 0.20^{d}	12.66 ± 0.11^{c}	25.18 ± 0.14^{a}	14.66 ± 0.19^{b}
Fat,%	1.44 ± 0.05^{c}	2.84 ± 0.35^{b}	1.66 ± 0.009^{c}	31.18 ± 0.62^{a}
Ash,%	0.48 ± 0.011^{d}	3.27 ± 0.091^{b}	1.59 ± 0.093^{c}	3.92 ± 0.040^{a}
Fiber,%	0.69 ± 0.023^{d}	3.65 ± 0.18^{b}	2.27 ± 0.16^{c}	21.33 ± 0.06^{a}
Carbohydrate, %	87.50 ± 0.18^{a}	77.57 ± 0.31^{b}	69.29 ± 0.17^{c}	28.89 ± 0.62^{d}

Data represented mean ± standard error (n = 3). Within each rows, different letters represent the significant difference among means ($p < 0.05$)

The highest value for moisture contents was 9.53% in wheat flour and the lowest value observed in safflower seed flour (6.74%). The percentage of 25.18% of protein content appeared in lentil flour [24], which represents the highest percentage compared to the rest of the other types of flour followed by safflower seed flour (14.66%) then sweet potato and wheat flour (12.66 and 9.89%, respectively) [25] . Safflower seed flour showed the highest values for fat, ash and fiber (31.18, 3.92 and 21.33%, respectively), followed by sweet potato flour (2.84, 3.27 and 3.65% respectively) then lentil flour (1.66, 1.59 and 2.27%, respectively). Wheat flour had the lowest content of fat, ash and fiber. The highest content of carbohydrate found in wheat flour (87.50%) while safflower seed flour represented the lowest content in carbohydrate (28.89%). These results agree with [26, 27].

3.2. Functional properties of wheat, sweet potato, lentil and safflower seed flours

Proteins' behavior in food systems throughout processing, preparation, storage, and consumption is influenced by their functional properties, which are those physical and chemical characteristics. These traits affect the food's organoleptic properties and quality [28]. Table 3 shows the functional characteristics of the flours made from wheat, sweet potatoes, lentils, and safflower seeds. Water holding capacity, bulk density, and dispensability of wheat, sweet potato, lentil, and safflower seed flours all differed significantly (p 0.05). The ability of flour to absorb water depends on the structure and compactness of the flour, and its water absorption capacity (WAC) determines how much water the flour can hold at room temperature. Water binding capacity depending on hydrogen bonding of water; entrapment of water [29].

Table (3)
Functional properties of wheat, sweet potato, lentil and safflower seed flours

Parameters,	Wheat flour	Sweet potato flour	Lentil flour	Safflower seed flour
Water holding capacity g/g	1.62±0.036 [b]	1.72±0.011 [b]	1.91± 0.037 [ab]	2.15±0.17 [a]
Bulk density g/ml	0.29±0.003 [a]	0.24±0.006 [b]	0.19±0.003 [c]	0.17±0.011 [d]
Dispersability, %	33.67±0.57 [b]	39.33±0.33 [ab]	41.33±0.39 [a]	45.00±0.57 [a]

Data represented mean ± standard error (n = 3). Within each rows, different letters represent the significant difference among means ($p < 0.05$)

The highest water holding capacity recorded in safflower seed flour (2.15 g/g) followed by lentil flour (1.91g/g), without significant differences between wheat flour and sweet potato flour (1.62 and 1.72 g/g, respectively). Bulk density is influential factor in food packaging and it is mainly affected by the particle size and the density of the flour [29]. Bulk density record 0.29, 0.24, 0.19 and 0.17 g/ml in wheat, sweet potato, lentil and safflower seed flours, respectively. Dispersibility is a characteristic that expresses the redistribution of flour samples in the water [30]. The safflower seed flour and lentil flour had the highest value of dispersibility which recorded 45.0 and 41.33%, respectively with no significant differences. The lowest value of dispersibility found in wheat flour (33.67%), this decrease may be attributed to the decreased fiber content of wheat flour compared to other flour samples.

3.3 Chemical composition of free gluten biscuits and wheat flour biscuit as a control

Table 4 shows the free gluten biscuit's chemical makeup as well as its mineral content. The chemical makeup of the control and free gluten biscuits differed significantly (p 0.05). Safflower flour concentration enhanced the moisture content, although there were no appreciable variations between samples A and B (3.87 and 3.97%) or C and D (4.35 and 4.39%). Without any discernible changes between C and D samples, the protein level in free gluten samples increased from 9.76% to 15.11% when compared to the control, possibly due to the high protein content of safflower flour and yellow lentil seed powder. [24, 31] .

Table (4) Chemical composition and minerals of free gluten biscuits and wheat flour biscuit as a control

Components	A	B	C	D
Moisture,%	3.87±.017 [b]	3.97±.033 [b]	4.35±.086 [a]	4.39±.034 [a]
Protein ,%	9.76±0.12 [c]	14.27±.19 [b]	14.81±0.10 [a]	15.11±0.11 [a]
Fat,%	11.07±0.076 [d]	11.92±0.070 [c]	12.14±0.026 [b]	12.35±0.062 [a]
Ash,%	1.043±0.023 [d]	1.50±0.031 [c]	1.99±0.006 [b]	2.45±0.075 [a]
Fiber,%	0.61±0.008 [c]	0.82±0.032 [c]	1.22±0.057 [b]	2.13±0.13 [a]
Carbohydrate, %	77.50±0.19 [a]	71.48±0.26 [b]	69.84±0.12 [c]	67.95±0.26 [d]
Energy,Kcal/100g	448.67	450.28	447.86	443.39
Zn, mg/kg	6.50	12.77	13. 32	15.13
K, mg/kg	891.00	2100	2139.75	2213.54
Na, mg/kg	6312	6232.50	5393.50	5274.79
Fe, mg/kg	21.75	29.87	38.50	41.50
Mg, mg/kg	215.50	783.13	811.57	837.34

Where: A= (100% wheat flour), B= (70% sweet potato flour+ 10% safflower seed flour+ 20% yellow lentil flour), C= (60% sweet potato flour+ 20% safflower seed flour+ 20% yellow lentil flour) and D=(50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour). Data presented as mean ± standard error (n = 3). Within each rows, different letters represent the significant difference among means ($p < 0.05$).

Safflower flour was added to free gluten biscuits to enhance fat, ash, and fibre, with effects that were significantly different ($p < 0.05$). In the D sample (50 % sweet potato flour, 30% safflower seed flour, and 20 % yellow lentil flour), it climbed from 11.07, 1.043, and 0.61%, respectively, in the control to 12.35, 2.45, and 2.13%, respectively. Due to the higher proportion of components in free gluten biscuits compared to controls, the carbohydrate content reduced from 77.50% in control (100% wheat flour) to 67.95% in D biscuit (50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour). While the amount of carbohydrates reduced, the amount of energy also fell, from 448.67 to 443.39 Kcal/100g. Regarding minerals, it is also clear from the same table (4) that the elements of Zn, K, Fe and Mg increased from 6.50, 891, 21.75 and 215.50 mg/kg, respectively in the control sample (A) to 12.77, 2100, 29.87and 783.13 mg/kg, respectively in the sample B (70% sweet potato flour+ 10% safflower seed flour+ 20% yellow lentil flour), 13. 32, 2139.75, 38.50 and 811.57 mg/kg, respectively in sample C (60% sweet potato flour+ 20% safflower seed flour+ 20% yellow lentil flour) and 15.13, 2213.54, 41.50 and 837.34 mg/kg, respectively in sample D (50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour). While the element Na decreased from 6312 mg/kg in control sample to 5274.79 mg/kg in sample D.

3.4 Physical properties of free gluten biscuit and wheat flour biscuit as a control

The weight (g), volume (cm3), specific volume (v/w), diameter (cm), thickness (cm), and spread ratio (%) of gluten-free biscuits were displayed in Table 5's results. There was no obvious difference between the control biscuit and the other gluten-free biscuit samples for the physical characteristics weight, volume, specific volume, thickness, and spread ratio. In terms of weight, volume, diameter, and spread ratio across free gluten biscuits, sample B (70% sweet flour+10% safflower seed flour) recorded higher values (4.62 g, 13.66 cm3, 4.33 cm, and 7.31, respectively), with no other significant differences with the other biscuit samples except diameters.

Table (5)
Physical properties of free gluten biscuit and wheat flour biscuit as a control

Parameters,	A	B	C	D
Weight, g	4.52±0.39[a]	4.62±0.075[a]	4.31± 0.037[a]	4.26±0.030[a]
Volume, cm^3	14.50±0.50[a]	13.66±0.29[a]	13.00±0.44[a]	12.66±0.16[a]
Specific volume, cm^3/g	3.22±0.15[a]	2.96±0.06[a]	3.01±0.13[a]	2.97±0.05[a]
Diameters, cm	4.47±0.014[a]	4.33±0.024[b]	4.28±0.067[bc]	4.22±0.037[c]
Thickness, cm	0.65±0.014[a]	0.59±0.007[a]	0.61±0.009[a]	0.64±0.009[a]
Spread ratio	6.85±0.14[a]	7.31±0.11[a]	7.02±0.17[a]	6.65±0.14[a]

Where: A= (100% wheat flour), B= (70% sweet potato flour+ 10% safflower seed flour+ 20% yellow lentil flour), C= (60% sweet potato flour+ 20% safflower seed flour+ 20% yellow lentil flour) and D=(50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour). Data presented as mean ± standard error (n = 3). Within each rows, different letters represent the significant difference among means ($p < 0.05$).

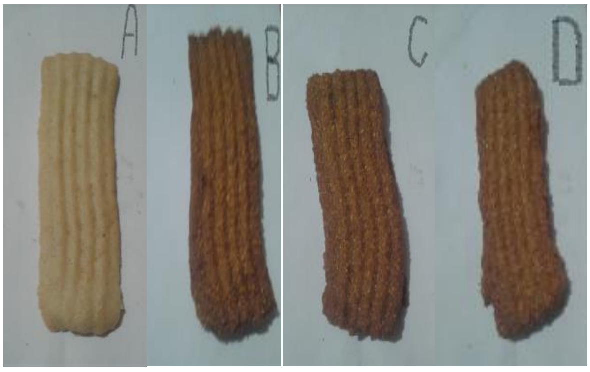

Figure (2): biscuit of A= (100% wheat flour), B= (70% sweet potato flour+ 10% safflower seed flour+ 20% yellow lentil flour), C= (60% sweet potato flour+ 20% safflower seed flour+ 20% yellow lentil flour) and D=(50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour)

Spread ratio decreased without significant differences by increasing safflower seed flour from 7.31in sample B (10% safflower seed flour+ 70% sweet potato flour) to 6.65in sample D (30% safflower seed flour+ 50% sweet potato flour), maybe as a result of the rise in fibre content. Non-wheat high protein flours or any other component that soaks up water while mixing the dough will lower the spread ratio because the water available in such a system won't be enough to dissolve the sugar during baking, raising viscosity and lowering the spread ratio [32]. The diameter to thickness ratio is known as the spread ratio, and biscuits with a higher spread ratio are regarded as the most desired [29].

3.5 Texture Profile of free gluten biscuit and wheat flour biscuit as a control

It is widely acknowledged how important texture is to consumer approval. According to [33], because of its direct ties to how people perceive freshness in baked products, hardness is the most crucial factor in evaluating baked goods. In Fig. 3, the hardness of a wheat-flour control and a free-gluten biscuit were both displayed. The hardness of the D biscuit (50 percent sweet potato flour, 30 percent safflower seed flour, and 20 percent yellow lentil flour) dropped from 40.22 N in the control biscuit to 30.38 N. The flour's composition has a significant impact on how hard biscuits are, and safflower seeds' high fibre content may be contributing to their increased hardness. **Becker et al.** [34] suggested that, in comparison to the control formula, the high fibre content helps to increase the hardness of cookies.

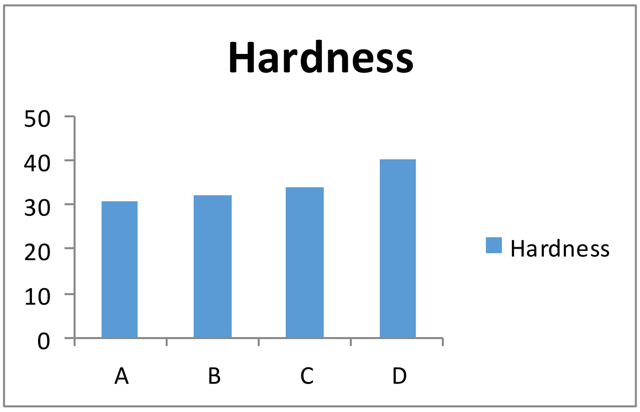

Figure (3): Hardness of free gluten biscuit and wheat flour biscuit as a control. Where: A= (100% wheat flour), B= (70% sweet potato flour+ 10% safflower seed flour+ 20% yellow lentil flour), C= (60% sweet potato flour+ 20% safflower seed flour+ 20% yellow lentil flour) and D=(50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour)

3.6 Sensory evaluation of free gluten biscuit and wheat flour biscuit as a control:

In order to determine the sensory differences between the free gluten biscuit and the control, a sensory acceptance test (Table 6) covering five characteristics and overall acceptability was conducted on cookies. The goal was to determine customer attitudes toward these goods and purchase intentions. All free gluten biscuit samples varied significantly from the control in terms of appearance, flavour, colour, texture, and general acceptance. Increasing the amount of sweet potato flour resulted in worse scores for appearance and colour. This could be because the sweet potato flour has a high sugar content, which may have led to browning in the rock buns created [35]. The taste parameter did not significantly differ between the B and D samples. The texture had low score as a result of increasing the level of safflower flour. The free gluten biscuit had similar score in overall acceptability.

Table (6)
Sensory evaluation of free gluten biscuit and wheat flour biscuit as a control

Parameters,	A	B	C	D
Appearance	9.00±0.00^{a}	7.00±0.29^{d}	7.66±0.16^{c}	8.33±0.17^{b}
Taste	9.00±0.29^{a}	8.50±0. 29^{ab}	7.70±0.29^{b}	8.00±0.57^{ab}
Odor	9.00±0.00^{a}	8.83±0.16^{a}	8.66±0.17^{a}	8.83±0.17^{a}
Color	9.00±0.00^{a}	7.33±0.33^{b}	7.83±0.17^{b}	8.66±0.33^{a}
Texture	7.83±0.17^{a}	7.33±0.16^{ab}	7.33±0.33^{ab}	7.00±0.00^{b}
Over all acceptability	8.77±0.33^{a}	7.80±0.15^{b}	7.80±0.11^{b}	8.17±0.14^{b}

Where: A= (100% wheat flour), B= (70% sweet potato flour+ 10% safflower seed flour+ 20% yellow lentil flour), C= (60% sweet potato flour+ 20% safflower seed flour+ 20% yellow lentil flour) and D=(50% sweet potato flour+ 30% safflower seed flour+ 20% yellow lentil flour). Data presented as mean ± standard error (n = 10). Within each rows, different letters represent the significant difference among means ($p < 0.05$)

The results recorded no significant differences in odor parameter in all sample compared to control. Finally, it could be concluded that, safflower seed flour could be incorporated up to 30% with 50% sweet potato flour and 20% yellow lentil flour in the formulation of free gluten biscuits without affecting their sensory quality, similar results had found by [36], they found that, the incorporation of lentil in free gluten cookies didn't effect on sensory evaluation.

Conclusion

It is possible to create gluten-free biscuits of acceptable physical and sensory quality using combinations of gluten-free flour. The sensory evaluation of flour mixtures (sweet potato, yellow lentil, and safflower) at ratios of 70:20:10, 60:20:20, and 50:20:30 are more acceptable for producing gluten-free biscuits. Additionally, the gluten-free biscuit had higher nutritional values (protein, ash, and fibre, as well as Zn, K, Fe, and Mg) than the control sample, in contrast to all samples' lower carbohydrate contents overall. However, there was no discernible difference between the gluten-free biscuit and the control biscuit in terms of instrumental weight, volume, diameters, or thickness. Therefore, the gluten-free biscuits made are good for patients with celiac disease, especially for young children who are deficient in zinc, potassium, iron, and magnesium.

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