Original Research Article

Improvement of the Nutritional Value of Rice Biscuits with Rich Natural Sources of Some Vitamins and Minerals

ABSTRACT

Aims: The purpose of this paper is to develop a biscuit incorporated with defatted soy fl our and strawberry powder to enhance its nutritional value of it.

Methodology: The proportion of rice fl our and defatted soy fl our were 25% and the level of strawberry powder used for making biscuit samples was 0, 5, 10 and 15% respectively. The biscuits were evaluated for their quality based on proximate analysis, physical properties and sensory evaluation.

Results: Based on chemical analysis protein, fi ber content and β -carotene level increased with increasing the amount of strawberry powder. The most preferred products were that with 25% defatted soy fl our and 10 per cent strawberry powder. It is noticed that 100gm of biscuits with 20% defatted soy fl our and 10% strawberry powder provide 4-8 years-old children with 44% of their needs of protein, 20.23% of their needs of iron, 19.06% of zinc and 48.01% of folate.

Conclusion: The addition of both defatted soy fl our and strawberry powder as a fl our replacer in gluten-free biscuits improves its nutritional value without aff ecting its physical properties and consumer acceptance.

Keywords: [gluten-free biscuits; rice fl our; defatted soy fl our; strawberry powder*]*

1. INTRODUCTION

Biscuits are ready to eat, convenient and inexpensive food products containing digestive and dietary principles of vital importance. It is also said to be an essential bakery confectionery, dried down to low moisture content and mostly rich in fat and sugar and consequently of high energy content. They are used at all times as snacks.

Rice is the seed of the grass species Oryza sativa (Asian rice) or Oryza glaberrima (African rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia.

Soybean (Glycine max) is a species of legume widely grown for its edible bean, which has numerous uses. Soy protein is essentially identical to the protein of other legume seeds and pulse (**Wolf, 2012**). It is one of the most important leguminous species because of its functionality, high nutritional value, and health benefits. (**Ren *et al*., 2006; Eke-Ejiofor and Williams, 2016**). Defatted soybean flour is a significant and cheap source of protein for animal feeds and many prepackaged meals. **Zaker *et al*., 2012** suggested that composite flour technology for wheat supplementation with protein-rich materials, like soybean, could be a way to overcome malnutrition around the world.

Strawberry plant is a member of the *Rosaceae* family and the genus *Fragaria*. The fruit usually wasted can be utilized for preparation of various value added products, which are of commercial importance from the industrial as well as health point of view. Together with vitamin C, strawberry is one of the richest natural sources of folate; its content is considered in the range of 20 to 25 mg/100 g Fresh Weight (FW). Moreover, the strawberry, although to a lesser extent, is a source of several other vitamins, such as thiamin, riboflavin, niacin, vitamin B6, vitamin K, vitamin A and vitamin E **(Giampieri *et al*., 2012).**

The purpose of this paper is to develop a biscuit incorporated with defatted soy flour and strawberry powder to enhance the nutritional value of it.

2. MATERIAL AND METHODS

2.1. Materials

Rice flour, defatted soy flour, strawberry and other ingredients were purchased from the local market in Cairo, Egypt. Chemicals were of analytical reagent grade.

2.2. Methods

2.2.1. Preparation of Fruit Powder

Strawberry fruits were washed and cut into thin slices. Slices were directly immersed in a 1% NaCl solution, and then, immersed in a solution containing sodium meta-bisulphite (1%) and citric acid (0.5%) for 3 min (**Shih *et al*., 2009**). Strawberry slices were dried at 55 °C. The dried slices were milled into flour and sieved (315 µm) into powdered form. The powder was then packed into polyethylene bags and kept at –20 °C for further analysis.

2.2.1. Preparation of Biscuits

Biscuit was made according to the standard procedure for sweet biscuits at Bisco Misr Co., Cairo with some modifications. The blends and formula of control biscuits and another suggestion formula to made biscuits were made according to **Wade (1988)** with some modifications; the formula is shown in Table (1).

Table 1: Formula of Biscuits

Ingredient (g)	Control (1)	Control (2)	F1	F2	F3
Rice flour	100	75	70	65	60
Sugar	30	30	30	30	30
Margarine	25	25	25	25	25
Mono-glyceride	3	3	3	3	3
Xanthan	1	1	1	1	1
Baking powder	5	5	5	5	5
Dry milk	5	5	5	5	5
Defatted Soy Flour	-	25	25	25	25
Strawberry Powder	-	-	5	10	15

The dough was sheeted to a thickness of about 3 mm using Atlas Brand rolling machine. The sheeted dough was cut into a round shape using a 45 mm diameter cutter and baked on an aluminum tray in an electric oven at 180°C for 15 minutes. The biscuit was cooled for 30 minutes, packed in polyethylene bags and stored at 20°C±2 at room temperature

2.2.4. Proximate analysis of ingredients and products

Rice flour, defatted soy flour, strawberry powder and biscuits were analyzed for moisture, protein, ash, fat and crude fiber according to the methods of **AOAC (2005)**. Total carbohydrate was calculated by difference. Total calories were calculated by the formula of **James (1995)** as follows:

Total calories = Fat x 9 + Protein x 4 + Total carbohydrate x 4.

Minerals content was determined in the diluted solution of ash raw materials and their blends using the atomic absorption spectrophotometer (3300 Perkin-Elmer) as described in by **AOAC (2012)**.

Vitamin A (B Carotene) was determined using (HPLC) (**Danish Official, 1996 a)**. Vitamin B1 (Thiamin) and B2 (Riboflavin) were determined using (HPLC) as mentioned by **(Danish Official, 1996 b)**. At Regional Center for Food and Feed (RCFF), Agricultural Research Centre, Giza, Egypt.

2.2.5. Physical characteristics of biscuits

Biscuits were evaluated for the weight (g), thickness (mm), diameter (mm) and spread ratio as described by **Gaines (1991).** The spread ratio was calculated from the ratio of diameter to the thickness and calculated using the following equation:

Spread ratio = Diameter / Thickness

2.2.4 Hardness of Biscuits

Biscuit hardness was determined using a Texture Profile Analyzer (TPA) according to the **AACC method (2002)**.

2.2.5 Sensory Evaluation of Biscuits

Biscuit samples were organoleptically evaluated for their sensory characteristics according to the method of **Larmond (1982)**. Samples were scored for color, flavor, crispiness, texture and overall acceptability by ten panelists from Food Technology Research Institute.

2.2.6 Statistical analysis

The analytical data were analyzed using SPSS 16.0 software. Means and standard deviations were determined using descriptive statistics. Comparisons between samples were determined using analysis of one-way variance (ANOVA) and multiple range tests. Statistical significance was defined at P≤ 0.05.

3. RESULTS AND DISCUSSION

3.1 Chemical Composition of Raw Materials

Our analysis showed 0.22% fat; 7.75 % protein; 0.23 % fiber; 0.62 % ash and 90.54 % carbohydrates for rice flour. Our results on rice flour were in agreement with work by **Omran and Hussien (2015);** who reported that rice flour had 7.78% proteins; 0.21% crude fiber; 0.66% ash, and 91.36% carbohydrates. While **Thanaa *et al.* (2019)** reported that rice flour had 7.75 proteins; 0.23% crude fiber; 0.62% ash, and 91.18% carbohydrates. Our results for rice flour were partly in agreement with **Cameron and Wang (2005)** found that milled rice flour had 6.60 to 9.30% protein, Fat content was in the range of that of **Srivastava *et al.* (2012)**. While fiber and ash contents are low in rice flour, these results agree with the work by **Saker and Hussien (2017).**

Results of table (2) indicated that the defatted soy flour protein was 47.01% and ash was 5.5%, these results are lower than the work by **Zaker *et al.* (2012)** who reported values of 62.73% for protein and 6.43% for ash. The results about the composition of defatted soy flour revealed that it is rich in protein content, which justifies its utilization as a novel ingredient in nutritional food preparations. The fat content was 1.22%, the fat remaining in defatted soy flour reveals the superior efficiency of the oil extraction process, while the 5.5 % of total ash reveals high mineral content. Crude fiber reached 2.90%; while carbohydrate was 62.61 %. Results also in the same table showed that defatted soybeans flour exhibited the highest amount of iron (9.24 mg/100g) and Zinc (Zn) (2.46 mg/100g). Our results are slightly lower than those reported by **Shalaby *et al.* (2018).** They reported iron to be (11.49 mg/100g) and Zinc (Zn) to be (10.35mg/100g). Defatted soybeans flour had the highest content in K (1.878 g/100g). **Turab (2017)** stated that the mineral composition of partially defatted soybean flour comprises around (25.62 mg/100g), (4.56 mg/100 g) and (274.07 mg/100 g) of iron, zinc and calcium respectively. While strawberry powder contains (4.75 mg/100g) of iron and (1.63 mg/100g) of zinc. Our results are in line with those reported by **Giampieri *et al*. (2012).**

Results also in the same table showed that defatted soybeans flour and strawberry powder had a high amount of folic (305.4, 221.3 ug/100g) and niacin (2.61, 2.09 mg/100g) respectively. Our results agree with those reported by **Andhale *et al.* (2020)** and **Giampieri *et al.* (2012)**.

Table 2: Chemical Composition of Raw Materials

	Rice Flour	Defatted Soy Flour	Strawberry Powder
Moisture (%)	9.54±0.05	7.25±0.15	11.00±0.12
Fat (%)	0.57 ±0.03	1.22±0.02	1.48±0.03
Protein (%)	6.95±0.15	47.01±0.10	2.40±0.05
Ash (%)	0.60±0.01	5.50±0.18	3.63±0.04
Crude Fiber (%)	0.20±0.03	2.90±0.15	6.82±0.13
Dietary Fiber (%)	0.23±0.02	1.33±0.10	9.20±0.07
Carbohydrate (%)	89.88±1.12	43.37±0.86	85.67±1.15
Vitamins			
Carotene (mg/100 g)	-	4.00±0.03	37.51±0.11
Folic Acid (ug/100g)	4.00±0.01	305.4±1.15	221.3±1.19
Thiamin (mg/100 g)	0.14±0.03	0.69±0.05	0.18±0.01
Riboflavin (mg/100 g)	0.02±0.01	0.25±0.03	0.64±0.05
Niacin (mg/100 g)	2.45±0.11	2.61±0.15	2.09±0.13
Vitamin B6 (mg/100 g)	0.44±0.05	0.57±0.07	0.55±0.08
Minerals			
Calcium (mg/100g)	10.3±1.19	241.00±1.12	175.12±0.15
Iron (mg/100g)	1.58±0.01	9.24±0.05	4.75±0.10
Zinc (mg/100g)	0.95±0.03	2.46±0.07	1.63±0.02
Magnesium (mg/100g)	35.01±0.15	209.15±0.75	90.91±0.14
Sodium (mg/100g)	1.1±0.02	20.12±0.03	9.10±0.05
Potassium (mg/100g)	76.3±0.25	358.05±1.15	1509.1±0.30

*Values are means of three replicates ±SD, on a dry weight basis. ** Total carbohydrates were calculated by difference.

3.2 Proximate Composition of Biscuits

Table -3- shows the proximate composition of biscuits produced from rice flour, defatted soybean flour and strawberry powder.

Protein content ranged from 4.82% to 8.47%. The result of this study revealed that protein content significantly increased with the addition of 25% defatted soy flour from 4.82% to 8.47%. Our results are in line with the work by **Banureka and Mahendran (2009) and Gayas *et al.* (2012).** The increase in protein content may be due to the addition of soybean flour in the biscuits. **Akubor and Ukwuru (2005)** said that soybean is a high protein legume and the incorporation of soy flour increases the protein content in the biscuits. Further addition of strawberry powder resulted in a non-significant decrease in protein content. This may result from the low content of protein in strawberry powder.

Fat content ranged from 17.76% to 17.93% fat content increased with the addition of soy flour and strawberry powder. Our results revealed that fat content slightly increased with the addition of 25% defatted soy flour from 17.76% to 17.90%. These results are in line with the findings of **Banureka and Mahendran (2009)** who reported the fat content of the biscuits increased from 14.6 to 24.0% with the increase in soybean flour from 0 to 25%. Further addition of strawberry powder resulted in a non-significant increase. These results are in line with the findings of **Saker and Hussien (2017)** who reported a value of 18.81% - 18.83% for biscuits produced from rice, chickpeas flour and date.

Ash content ranged from 0.72% to 1.83%. The result of this study revealed that ash content increased with the addition of 25% defatted soy flour and the increase in the level of strawberry powder. Our results are higher than the work by **Eke-Ejiofor and Williams (2016).** They reported ash in rice biscuits supplemented with defatted soy flour to range between 2.31 to 2.72 for 20 to 30% soy flour. **Sanni *et al.* (2008)** reported that the ash content of a food material could be used as an index of mineral constituents of the food because ash is the inorganic residue remaining, after the water and organic matter have been removed by heating in the presence of an oxidizing agent.

Fiber content ranged from 0.11% to 1.84%. The fiber content of biscuits produced agrees with the findings of **Saker and Hussien (2017)** with values ranging between 0.79% and 1.21%. The total crude fiber content significantly increased in biscuit samples with substitution level of strawberry powder, this may be due to the higher content of these nutrients in strawberry powder These results are in line with work by **Sindhu *et al*. (2016)** who reported that the different level of carrot pomace powder increased the total crude fiber content significantly in biscuit samples.

Carbohydrate content ranged from 76.59% to 69.93% with a sample with 25% defatted soy flour and 15% strawberry powder as the lowest and control as the highest. The result of this study showed that an increase in substitution levels increased decreased the carbohydrate content. The results of biscuits produced agree with the findings of **Sindhu *et al.* (2016).** However, the high protein and low carbohydrate content of composite biscuits is an indication that the biscuits may serve as a functional food for groups with special caloric and glycemic requirements such as obese or diabetic people (**Eke-Ejiofor and Williams 2016)**. **Akubor and Ukwuru (2005)** suggested that soy thereby has a greater potential in overcoming protein-calorie malnutrition in the world.

Table -3-: Proximate Composition of Biscuits

Treatment	Protein (%)	Fat (%)	Ash (%)	Crude Fiber (%)	Carbohydrate (%)

Control (1)	4.82± 0.16 b	17.76± 0.02 b	0.72± 0.02 e	0.11± 0.01 e	76.59± 0.03 a
Control (2)	8.47± 0.03 a	17.90 0.04 a	1.12± 0.03 d	0.83± 0.02 d	71.81± 0.16 b
F1	8.44± 0.06 a	17.91 0.08 a	1.44± 0.04 c	1.17± 0.02 c	71.12± 0.15 c
F2	8.36± 0.03 a	17.92± 0.01 a	1.63± 0.03 b	1.52± 0.05 b	70.49± 0.13 d
F3	8.35± 0.01a	17.93 0.04 a	1.83± 0.02 a	1.84± 0.03 a	69.93± 0.10e

*Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level.

3.2 Vitamin and Mineral Content of Biscuits

Table -4- shows the vitamin content of biscuits produced from rice flour, defatted soybean flour and different levels of strawberry powder. Data show a significant increase in vitamins with the addition of 25% defatted soy flour and different levels of strawberry powder.

Table -4-: Vitamin Content of Biscuits

Treatment	Carotene (mg/100 g)	Folic acid (ug/100g)	Thiamine (mg/100 g)	Riboflavin (mg/100 g)	Niacin (mg/100 g)	Vitamin B6 (mg/100 g)
Control (1)	0.64± 0.14 e	3.04± 0.05 e	0.08± 0.01 b	0.04± 0.02 d	1.54± 0.02 b	0.25± 0.02 c
Control (2)	1.55± 0.17 d	63.93± 0.03 d	0.17± 0.02 a	0.08± 0.01 c	1.56± 0.01 a	0.28± 0.02 b
F1	6.75± 0.11 c	78.94± 0.04 c	0.17± 0.03 a	0.11± 0.01 b	1.56± 0.05 a	0.30± 0.01 ab
F2	8.36± 0.25 b	96.04± 0.02 b	0.17± 0.02 a	0.12± 0.02 b	1.56± 0.01 a	0.30± 0.01 ab
F3	10.81± 0.13 a	115.06± 0.05a	0.17± 0.03 a	0.16± 0.01 a	1.56± 0.02 a	0.32± 0.02 a

*Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level.

All vitamins increased with the addition of defatted soy flour; β-carotene increased from 0.64 to 1.55 mg/100 g, thiamine 0.08 to 0.17 mg/100 g, riboflavin 0.04 to 0.08 mg/100 g and vitamin B6 0.25 to 0.28 mg/100 g. Folic acid increased from 3.04 to 63.93 mg/100 gm. This may be due to the high content of vitamins in defatted soy flour. These results agree with the work by **Shalaby *et al.* (2018)**. They reported a slight increase in beta-carotene, B1 and B2 in complementary infant food.

Further addition of strawberry powder resulted in a further increase in vitamin content, β-carotene increased from 1.55 to 10.81 mg/100 g, riboflavin 0.08 to 0.16 mg/100 g and vitamin B6 0.28 to 0.32 mg/100 g. While Folic acid increased from 63.93 to 115.06 ug/100 g. This may be due to the high content of vitamins in strawberry powder. These results agree with the work by **Giampieri *et al*. (2012).**

Table -5-: Mineral Content of Biscuits

Treatment	Ca (mg/100 g)	Fe (mg/100 g)	Zn (mg/100 g)	Mg (mg/100 g)	Na (mg/100 g)	K (mg/100 g)
Control (1)	15.43± 0.05 **e**	0.27± 0.02 **e**	0.65± 0.03 **c**	20.54± 0.40 **e**	6.83± 0.08 **e**	32.54± 0.04 **e**
Control (2)	58.74± 0.01 **d**	1.74± 0.03 **d**	0.91± 0.02 **b**	66.76± 0.50 **d**	10.05± 0.13 **d**	105.55± 0.19 **d**
F1	67.04± 0.04 **c**	1.84± 0.04 **c**	0.94± 0.03 **ab**	68.56± 0.05 **c**	13.34± 0.04 **c**	115.91± 0.17 **c**
F2	75.42± 0.02 **b**	2.03± 0.06 **b**	0.95± 0.04 **ab**	70.41± 0.02 **b**	16.65± 0.08 **b**	123.23± 0.07 **b**
F3	84.75± 0.03**a**	2.13± 0.02 **a**	0.97± 0.01 **a**	72.22± 0.09 **a**	19.94± 0.03 **a**	134.52± 0.02 **a**

*Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level.

Table -5- shows the mineral content of biscuits produced from rice flour, defatted soybean flour and different levels of strawberry powder. Data show a significant increase in minerals with the addition of 25% defatted soy flour and different levels of strawberry powder.

All minerals increased with the addition of defatted soy flour, calcium increased from 15.43 to 58.43 mg/100g, iron from 0.27 to 1.74 mg/100g, zinc 0.65 to 0.91 mg/100g, magnesium 20.54 to 66.76 mg/100g, sodium 6.83 to 10.05 mg/100g and potassium 32.54 to 105.55 mg/100g. These results agree with the work by **Omoba and Omogbemile (2013) and Ndife *et al.* (2014).** This increase may be due to the high mineral content of defatted soy flour (Table 2).

Table 5, also shows the effect of further substitution of rice flour with strawberry powder on the mineral composition of biscuits. Calcium increased from 58.43 to 84.75 mg/100g, iron from 1.74 to 2.13 mg/100g, zinc 0.91 to 0.97 mg/100g, magnesium 66.76 to 72.22 mg/100g, sodium 10.05 to 19.94 mg/100g and potassium 105.55 to 134.52 mg/100g. This increase may be due to the mineral content of strawberry powder (Table 2). These results agree with the work by **Aya Sakhaneh (2021).**

3.3 Physical Properties of Biscuits

The physical properties of biscuits are important for both manufacturers and consumers. Table 6 shows the results of the evaluation of biscuits prepared from the mixture of rice flour, defatted soy flour and strawberry powder for several physical characteristics.

Table - 6 -: Physical Properties of Biscuits

Treatment	Weight (g)	Diameter (mm)	Thickness (mm)	Density (g/mm^3)	Spread Ratio D/T
Control (1)	6.01±0.02f	43.95±0.02a	6.08±0.01a	0.41±0.09 e	7.22±0.02 c
Control (2)	7.10±0.03e	43.90±0.07d	6.52±0.09b	0.57±0.02 d	6.73±0.03 b
F1	7.71±0.05d	43.81±0.05e	6.54±0.04d	0.61±0.03 c	6.69±0.05 b
F2	8.25±0.03c	43.60±0.01c	6.60±0.07e	0.65±0.07 b	6.60±0.03 a
F3	8.50±0.05c	43.20±0.05b	6.66±0.05c	0.68±0.08 a	6.48±0.02 a

*Values are means of three replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level.

Results show a significant increase in the weight of biscuits after the supplementation of defatted soy flour and strawberry powder. Weight increased from 6.01 to 7.10 g with the addition of defatted soy flour. The addition of defatted soy flour increased the weight, this agrees with the work by **Omoba and Omogbemile (2013).** The incorporation of strawberry powder resulted in a further increase in weight, our results agree with the work by **Saker and Hussien (2017).**

The diameter of biscuits decreased from 43.95 mm to 43.90 mm. The results agree with the work by **Omoba and Omogbemile (2013).** The incorporation of strawberry powder resulted in a further decrease in diameter from 43.90 to 43.20 mm. The decreasing trend was directly proportional to the increasing level of strawberry powder substitution. The results also show a significant decrease in the diameter of biscuits after the supplementation of defatted soy flour and strawberry powder. Our results agree with the work by **Fahim *et al.* (2020)** and **Omran and Hussien (2015).** The decrease in the diameter of biscuits was suggested, by **Ajila *et al.* (2008),** to be due to the increase in fiber contents, which in our case is strawberry powder, which is a rich source of fiber (6.82 g/100g) compared with 2.90 g/100g for defatted soy flour and 0.23 g/100g for rice.

The thickness of biscuits also increased significantly from 6.08 to 6.66 mm with the addition of defatted soy flour and strawberry powder. The addition of defatted soy flour increased from 6.08 to 6.52 mm. This agrees with the work by **Zaker *et al.* (2012).** They attributed this increase to the better binding strength of soy protein. While the addition of strawberry powder resulted in a further increase in thickness from 6.52 to 6.66 mm. Our results agree with the work by **Omran and Hussien (2015)** and **Saker and Hussien (2017).**

The same is true for the spread ratio which decreased linearly whereas, density increased similarly**. Kissell and Yamazaki (1975)** explained this that non-wheat high protein flours or any other ingredient which absorbs water during dough mixing will reduce the spread ratio because the water available in such a system would be insufficient to dissolve sugar during baking, increasing the viscosity and resulting in lower spread ratio**. Vieira *et al.* (2007)** established that the spread ratio is strongly correlated to the water absorption capacities of the flour.

3.4 Texture Profile of Biscuits

Texture's importance in the consumer acceptance of bakery products is highly recognized. Hardness is the most important in the evaluation of baked goods, because of its close association with the human perception of freshness **(Karaoğlu and Kotancilar, 2009).**

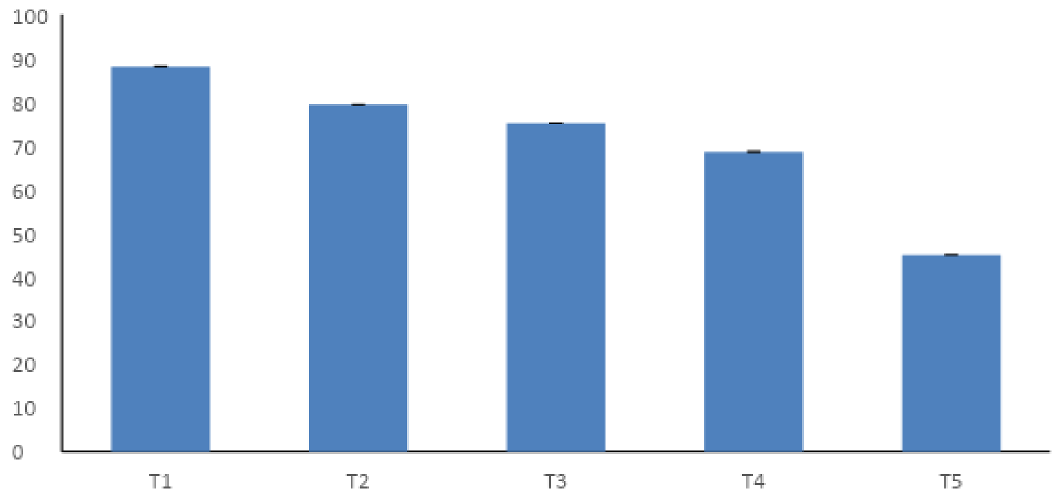

Fig 1: Hardness of Biscuits
*Values are means of three replicates, numbers with the same letter are not significantly different at 0.05 level.

Hardness is illustrated in Fig. 1. Significant differences in hardness were observed between substituted and control biscuits; the addition of defatted soy flour resulted in a high decrease in the hardness (from 88.1 to 75.11 N). These results agree with the work by **Zaker *et al.* (2012).** They reported that defatted soy flour incorporated biscuits reported to have a lower hardness. This could be attributed to the high water binding capacity of defatted soy flour. While the further addition of 5% strawberry powder resulted in a less decrease in hardness (75.11 to 68.61 N). Further, an increase in strawberry powder level from 5% to 15% results in a further decrease in hardness (68.61 to 45.25 N respectively). Our results agree with the work by **Omran and Hussien (2015)** who reported that the hardness of cookies is much affected by the composition of flour. Results are also comparable with the work of **Uysal *et al*. (2007), Toma *et al*. (2009)** and **Qaisrani *et al*. (2014)**. Also, the decrease in hardness may be because of the high fiber content of both defatted soy flour and strawberry powder.

3.5 Sensory Evaluation of Biscuits

The preference for the products, in terms of the sensory parameters used in assessing the product. Biscuits produced from different ingredients of defatted soy flour and strawberry powder were sensory-evaluated and compared with control biscuits (100% rice flour) (Table 7).

Table 7: Sensory Evaluation of Biscuits

Treatment	Appearance (20)	Taste (20)	Texture (20)	Color (20)	Flavor (20)	Overall (100)
Control (1)	16.27±0.07^{d}	17.25±0.03^{c}	17.96±0.05^{c}	17.50±0.04^{c}	18.06±0.02^{c}	69.48±0.31^{d}
Control (2)	17.25±0.02^{c}	17.25±0.03^{c}	17.98±0.06^{c}	17.55±0.04^{c}	18.02±0.02^{c}	88.05±0.24^{c}
F1	18.25±0.06^{b}	17.95±0.07^{b}	18.87±0.05^{b}	18.55±0.04^{b}	19.10±0.04^{b}	92.72±0.52^{b}
F2	18.95±0.05^{a}	18.97±0.04^{a}	19.10±0.06^{a}	18.70±0.02^{a}	19.13±0.03^{b}	94.85±0.10^{a}
F3	18.25±0.06^{b}	18.90±0.02^{a}	18.87±0.05^{b}	19.25±0.04^{a}	19.25±0.04^{a}	94.52±0.52^{a}

*Values are means of ten replicates ±SD, numbers in the same column followed by the same letter are not significantly different at 0.05 level.

As shown in Table 7, the overall acceptance and other parameters of the biscuits were affected by the additives. Biscuits with 25% defatted soy flour and 10% strawberry powder had the highest score in all parameters, except flavor where 15% strawberry powder had the highest score. Such data are in line with **Aya Sakhaneh (2021)** findings.

Therefore, it could be recommended to produce gluten-free biscuits with good quality and acceptable sensory quality attributes with the addition of 20% defatted soy flour and 10 % strawberry powder.

3.6 Nutritional Evaluation of Biscuits

The percentages of the recommended dietary allowances (% RDA) provided from 100g of biscuits, for children 4-8 years, are shown in table -8-. It could be observed that supplementation of biscuits with 25% defatted soy flour covers up to 44.57% of protein requirement, 17.43% of the iron requirement, 18.13% of zinc and 5.87% of calcium. The addition of strawberry powder increases the folate, calcium, iron and zinc provided by biscuits to 57.53, 8.47, 21.36, and 19.46%, respectively.

Table 8: Percentages of the Recommended Dietary Allowances Provided from Gluten-Free Defatted Soy Flour and Strawberry Biscuits for Children (4-8 years)

Treatment	Protein (% RDA)	Folate (% RDA)	Calcium (% RDA)	Iron (% RDA)	Zinc (% RDA)
Control (1)	25.08^{c}	1.52^{e}	1.54^{e}	2.70^{e}	13.13^{d}
Control (2)	44.57^{a}	31.97^{d}	5.87^{d}	17.43^{d}	18.13^{c}
F1	44.43^{a}	39.48^{c}	6.70^{c}	18.36^{c}	18.87^{b}
F2	44.00^{b}	48.01^{b}	7.54^{b}	20.23^{b}	19.06^{ab}
F3	43.94^{b}	57.53^{a}	8.47^{a}	21.26^{a}	19.46^{a}

(**Food and Nutrition Board, Institute of Medicine, & National Academies, 2004)**
*Numbers in the same column followed by the same letter are not significantly different at 0.05 level.

3.1 Subheading Subheading (ARIAL, BOLD, 11 FONT, LEFT ALIGNED) - second level heading.

3.1.1 Sub-subheading (ARIAL, BOLD, 10 FONT, LEFT ALIGNED, underlined)- third level heading.

3.1.1.1 Sub-sub-subheading **(ARIAL, ITALICS, BOLD, 10 FONT, LEFT ALIGNED)** - fourth level heading.]

4. CONCLUSION

The potential of strawberry fruit powder as a flour replacer in gluten-free biscuits was studied. Increasing substitution levels increased the ash and dietary fiber in the product. The most preferred product was that with 20% defatted soy flour and 10% strawberry powder. It is noticed that 100g of biscuit with 25% defatted soy flour and 10% strawberry powder provides 4-8 years-old children with 44% of their needs of protein,

20.23% of their needs of iron, 19.06% of zinc and 48.01% of folic acid. This will help in the utilization of strawberry fruit while micronutrients and fiber present in the strawberry fruit will provide some nutritional and health benefits for consumers.

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