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Characterization of incorporated Biscuit with Jatropha seed as non-traditional protein

Marwa H. Mahmoud [1],* Azza A. Abou-Arab [1], Dorria M.M. Ahmed [2], Ferial M. Abu-Salem [1]

1 Department of Food Technology, National Research Centre, 33 Bohouth St., Dokki, Giza, Egypt

2 Pomology Department, Agriculture and Biological Division, National Research Centre, 33 Bohouth St., Dokki, Giza, Egypt.

Abstract

Lack of food products with high protein in many flour-based products is an issue of great concern, consequently, our aim was to use detoxified jatropha seed as non-traditional protein source to produce biscuit with high protein content. Results showed that formulated biscuits gave high levels of protein 33.82 also, ash was increased and crude fiber was decreased with increasing quantity of Jatropha flour. Energy of biscuit had a significant ($P<0.05$) decreased from control sample 562.29 to sample 15% additive 513.93 Kcal/100g. Essential amino acids were present in greater concentrations than in the FAO reference protein pattern (35.69 g/100 g protein). Sensory evaluation revealed that formulated biscuit with Jatropha fortification had a good acceptance value for all samples. Both of 5 and 10% in formulated biscuits were the most suitable levels of fortification. *Jatropha curcas* detoxified flour could be a viable source of protein for fortifying a variety of wheat-based diets.

Keywords: Detoxified jatropha seed flour; non-traditional protein source; fortified biscuit.

Introduction

Taste, safety, convenience, and nutrition have all raised consumer demand for high-quality food items, as a result, nutrition has become a new facet of the food chain's evolution [1]. Attempts are attempted to improve the nutritional value and usefulness of biscuits by adjusting their nutritive composition, such as by boosting protein content, for reasons relating to market rivalry and rising demand for natural, healthy, and functional products. Protein is necessary for children's growth, healing, and maintenance. It also serves as an enzyme and a hormone, ensuring fluid, electrolyte, and acid-base balance as well as a healthy immune system [2]. Protein also serves as a transporter for vitamin A, lipids, iron, potassium, and sodium, among other nutrients. [2]. Increasing whole grain ratio of raw material, except wheat to increase protein and mineral content in bread goods is a common way to improve quality [3]. Thus, the low nutritive value of bakery products especially, biscuit which is the almost widely consumed snack by kids, who require a lot of protein per unit body weight, their low nutritional content is a major problem. Biscuits are made to be eaten as a quick and economical snack [4], which is very popular and well accepted particularly among children in Egypt and other countries due to it's easy to handle, natural components, long shelf life, affordable cost and availability in different varieties. In order to create high-density protein biscuits that will act as functional food with their health benefits, nutritionally balanced biscuits with a suitable amount of protein and a high biological value are required. [4, 5]. Utilization of composite flours for the production of biscuits to improve its protein content was estimated by several workers [6]. Composite flours are beneficial in that the necessary amino acids tryptophan, threonine, and lysine (which are deficient in wheat flour) are supplied from several sources. Composite meals, which are prepared by mixing cereal and legume flours in a set proportion to improve nutritive qualities, boost protein content over cereal formulations, and improve the balance of amino acid due to the presence of legume lysine and cereal methionine, can be fortified. The nutritional, functional, sensory, and phytochemical aspects of final meals are also affected by composing. [7]. It will add advantage of improving the nutrient value of

*Corresponding author e-mail: marwahanafy78@yahoo.com (Marwa Hanafy Mahmoud)
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baked food products particularly when cereals are mixed with unusually protein source such as crude germinated Jatropha seed (CGJS) lipase flour. Composite flour can also be described as a blend of non-wheat flour with or without the addition of wheat flour [8].

With regarding the functional properties, Jatropha seed could be considered as a good source of oilseed proteins (32.88 %) [9], comparing to rapeseed, canola, or sunflower protein [10]. After extraction of oil, *Jatropha curcas* seed cake protein content varied between 50-64 % [10]. With the exception of lysine, the content of cake essential amino acids was found to be higher. FAO recommendations for growing children at the age of 2–5 is available [11]. Also, sulphur amino acids are higher in *Jatropha curcas* seed cake. Thus, the seed cake has the potential to be used as a protein supplement [12], but cannot be used as such owing the presence of toxic and anti-nutrient components [13]. Even though the protein in jatropha has strong functional qualities, there are few accounts of its use in food [14, 15], as a results of containing toxic substances called phorbol esters, which hinders the nutritional use of these seeds.

Different methods have been employed for the detoxification of the Jatropha seed cake that could be utilized as good rich protein source as a dietary supplement for food and feed indicating good nutritional value [10, 16]. Nevertheless, there hasn't been much research or information published regarding the use of detoxified *Jatropha curcas* seed flour in fortifying biscuits.

Therefore, the present study had undertaken non-traditional protein source to produce the biscuit supplemented with crude germinated Jatropha seed (CGJS) lipase flour as detoxified seeds for improving protein content as functional food.

2. Materials and Methods

2.1. Materials

Jatropha specie (*Jatropha curcas* L.) cultivars in 2019 (6 years old) at South Sinai Government was used. Chemicals and reagents were purchased from Sigma. Analytical-grade substances and reagents were also used.

2.2. Detoxification of *Jatropha curcas* seeds

The sample was cleaned manually and de-hulled to access endosperm, then it was powdered and the oil was extracted by soxhlet apparatus, using hexane (fat <1%) dried at open-air (25 ± 2°C) and store at 4° C according to the method described by Abou-Arab et al. [16].

2.3. Preparation of germinated *Jatropha curcas* flour

Germination of *Jatropha curcas* seeds by stimulation of lipase enzyme was prepared according to [17]. After that, 5 g defatted meal was placed in Erlenmeyer flask, then one gram powder was added to it, in addition to 40 mL phosphate buffer pH 7.0, then, it was incubated at 30° C for 12 hrs, then it was placed into ice bath to terminated the reaction.

2.4. Preparation of dough and baking biscuits

Biscuit was made according to the method described by Krystyjan et al. [18] with modification of Mahmoud et al. [19].Dry ingredients were mixed together (wheat flour: 100 g, shortening: 50 g, sugar powder: 45.5 g, eggs: 15 g, vanilla-flavoured sugar, 0.3 g, baking powder: 2 g). The dough was mixed for 10 min to obtain a homogeneous consistency and then placed into the fridge at 6 °C over a period of 30 min. The dough was sheet to a thickness of about 3 mm using rolling machine. The sheet dough was cut into round shape using a 45 mm diameter cutter and baked at 180° C for 20 min. The biscuits supplemented with crude germinated Jatropha seed (CGJS) lipase flour was prepared with replacing wheat flour with Jatropha powder at the levels 2.5, 5.0, 10.0 and 15.0 %. Control sample (without CGJS).

2.5. Analysis of Jatropha seed (CGJS) flour and formulated biscuit

2.5.1. Proximate analysis

Moisture, fat, protein, ash and crude fiber of wheat flours, crude germinated Jatropha seed (CGJS) lipase and biscuit were measured according to the method outlined in AOAC [20]. The total carbohydrates calculated by difference method. Total calories of samples were estimated by formula [21] as follows:

Total calories = (Protein X 4) + (Fat X 9) + (Total carbohydrates X 4)

2.5.2. Amino acid content crude germinated Jatropha seed (CGJS) lipase flour

Sample was hydrolyzed using 6M HCl for 24 h at 100°C vacuum oven and amino acids were analyzed using high performance Amino acid analyzer (Biochrom 30, China) [22].

2.6. Baking quality of biscuit

Diameter (D), thickness (T), spread ratio (SR) and spread factor (SF) of six biscuits as described in the method outlined in AACC [23]. Spread factor (SF) was calculated as:

SF = (D X 10)/T

2.7. Physical characteristics of formulated biscuit

2.7.1. pH value

It was determined by using pH meter (model Cyber Scan 500) according to the method outlined in AOAC [20].

2.7.2. Color measurements

Hunter colorimeter model D2s A-2 (Hunter Assoc. Lab Inc., USA) was used for the measurement. L* = lightness (0 for black, 100 for white), a* = red-green dimension (- a for greenness, + a for redness), and b* = yellow-blue dimension (- b for blueness, + b for yellowness). Color difference (ΔE*) was calculated from a, b, and L parameters, using equation: $\Delta E^* = (\Delta a^2 + \Delta b^2 + \Delta L^2)^{½}$; according to the method described by Mahmoud et al. [24].

2.8. Sensory attributes of biscuits

Acceptability and quality of biscuit were evaluated for formula with additive levels (0, 2.5, 5.0, 10.0 and 15 %) crude germinated Jatropha seed (CGJS) lipase flour in Food Technology Department, National Research Centre, Egypt. Ten panelists between 30 and 50 years old well trained were selected to participate sensory evaluation of taste, color, odor, texture, flavor and overall-acceptability according to the method described by Mahmoud et al. [25]. Ten-point hedonic scale was used for evaluating taste, color, odor, flavor, texture and overall-acceptability. as following: 1-dislike extremely to 10=like extremely.

2.9. Statistical analysis

All obtained data were statistically subjected to one-way analysis of variance (ANOVA), means separation was performed by Duncan's Multiple Range Test (DMRT) with $P \leq 0.05$ being considered statistically significant (SPSS, package version 16.0).

3. Results and Discussion

Table 1 represents the chemical composition of CGJS flour and wheat flour, explaining the difference between them, as jatropha flour is characterized by its high content of moisture, protein, ash, fiber and fat, and its low energy content.

3.1. Chemical composition of biscuits formulated with different levels of (CGJS) flour

The chemical composition of formulated biscuits made from crude germinated Jatropha seed (CGJS) lipase flour are presented in Table 1. Significant differences ($P < 0.05$) were found in both of proximate composition and energy content of formulated biscuits. Both of moisture, protein and ash were increased as the levels of (CGJS) lipase flour increased. From the table 1, it could be seen that the decrement in values were for moisture content (1.53 to 6.39 %), protein (15.20 to 33.82 %), fat (25.93 to 28.97 %), ash (0.93 to 1.34 %), crude fiber (1.50to 3.13 %); total carbohydrate value (29.48 to 67.03%); while the energy content was ranged between (562.29 to 513.93 Kcal/100g) in both of flour and CGJS, respectively. This might be due to CGJS's strong water-binding ability, which allowed for greater moisture content in the final product [32]. When compared to the required storage moisture level for grain and prepared biscuits, the moisture content of biscuits generated revealed that they could be stored for long periods of time [33]. The protein content for the biscuits was higher than that prepared from potato and soybean as reported by [34, 35]. The minerals found in Jatropha curcas seeds were most likely response for the increased of ash levels (potassium, magnesium, calcium, among others) [36]. The results obtained were similar to that of [37] for macrotermes subhyalinus-fortified biscuits. Increased crude fiber may result in bulkiness and poor nutritional caloric intake [38]. The values obtained were still higher than that reported by [39, 40] for biscuit fortified with lentil and maize bran. It was seen that as the quantity of (CGJS) lipase flour was increased as a result of carbohydrate decreased. Total carbohydrate values of the biscuit samples ranged between 54.13 and 69.02%, as stated by [41].

Energy was estimated by calculated total calories of the formulate biscuit. It was significantly decreased by the addition of (CGJS) lipase flour from 562.29 for wheat biscuit to 513.93 Kcal/100g for CGJS lipase biscuit, based on the quantities of the added partially (CGJS) lipase flour. That decreased in estimated energy of (CGJS) lipase flour biscuits were related to the low fat and carbohydrate content of jatropha. These results reflected the high nutritive values and relatively low calories content of CGJS, which related to low carbohydrate content in CGJS. This work was agreed with [41] who demonstrated that, increasing the level of flaxseed in biscuit led to higher energy of biscuit, as a result of high fat content.

3.2. Amino acid composition of Jatropha (CGJS) flour

The amino acid content of Jatropha (CGJS) flour is shown in Table 2. Leucine is the necessary amino acid with the highest concentration (6.71 g/100 g protein). The quantities of the essential amino acids valine, leucine, isolucine, histidine, and therionine were greater than the FAO reference protein pattern as shown in (Table2) [27, 28, 29]. In comparison to casein, jatropha has lesser quantities of critical amino acids, but larger levels of methionine and cystein [30]. In the same (Table 2), the non- essential amino acids of crude germinated Jatropha seed (CGJS) lipase flour, glutamic acid is the most highly concentrated (12.97 g/100g protein) followed by aspartic acid (11.52 g/100g protein) and arginine (11.29 g/100g protein). The least non- essential amino acids are proline (4.25 g/100g protein). A protein's nutritional value is largely determined by its ability to meet nitrogen and critical amino acid requirements.

Table 2 shows that with considering histidine, essential amino acids of crude germinated Jatropha seed (CGJS) lipase flour (35.69 g/100 g protein) compared favorably to Prosopis africana concentrate (31.9 g/100 g protein) published by [31]. The total Acidic Amino Acid (TAAA) (24.49 g/100 protein) is larger than the quantity of basic amino acids (TBAA) (14.16 g/100 g protein), reflecting that crude germinated Jatropha seed (CGJS) Lipase flour is most likely acidic.

Total Sulphur Amino Acid (TSAA) content was 3.16 g/100 g protein, which is near to half of the recommended amount (5.8 g/100 g protein) for infant [27]. The ratio of EAA to TAA was 45.53 percent in the flour. This was significantly over the 39 % regarded acceptable for optimum protein meals for infants, children, and adults, as well as the 26 %, 11

%, and 11 %, respectively [27]. According to the amino acid composition of the investigated (CGJS) lipase flour, its protein offers a modest nutritional value.

Table 1. Proximate composition (% on dry weight) of Jatropha (CGJS) lipase flour and the biscuit formulated with different levels of it.

Treatments	Moisture	Protein	Fat	Ash	Crude fiber	Total carbohydrates*	Total calorie (Kcal/100g)
WF	12.82^{b}±1.02	12.53^{b}±1.02	0.86 ^{f}±0.02	0.50 ^{f}±0.03	3.13^{a}±0.03	73.29	351.42^{e}±3.0
(CGJS) lipase flour	20.57 ^{a}±2.0	50.49 ^{a}±2.0	1. 35 ^{e}±0.02	6.62 ^{a}±1.02	1.36 ^{e}±0.02	20.97	297.99 ^{f}±2. 31
T0 (Control)	1.53^{g}±0.17	15.20^{d} ±2.0	25.93^{d} ±1.05	0.93^{e}±0.02	2.87^{b-} ±0.02	67.03	562.29^{a} ±3.0
T1 (2.5 %)	2.02^{f}±0.21	21.73^{c} ±2.0	26.47^{c}±1.02	1.00^{d}±0.03	1.50^{de} ±0.02	48.78	520.27^{c} ±4.0
T2 (5.0 %)	2.44^{e} ±0.43	25.53^{bc}±2.02	27.64^{bc}±1.08	1.09^{cd}±0.02	1.59^{d} ±0.02	43.30	524.08 ^{b} ±3.0
T3 (10.0 %)	3.84^{d}±0.02	28.72^{b}±3.0	28.15^{ab}±1.02	1.16^{c}±0.03	1.74^{cd} ±0.03	38.13	520.75 ^{c} ±4.0
T4 (15.0 %)	6.39^{c}±0.16	33.82^{a}±2.0	28.97^{a}±1.1	1.34^{b}±0.02	1.99^{c} ±0.02	29.48	513.93 ^{d} ±3.14

All values are means of triplicate determinations ± standard deviation (SD).
Means within columns with different letters are significantly different ($P<0.05$).

Total carbohydrates* was calculated by differences   Total calories = (Fat X 9) + (Protein X 4) + (Total carbohydrates X 4)

Table 2. Amino acid composition of Jatropha seed (CGJS) flour and suggested by FAO/WHO for 2-5 year old children

Essential amino acid	**(g/100 g protein)**	**FAO/WHO [a] reference**
Cysteine	1.61	2.50
Methionine	1.55	2.50
Valine	4.72	3.50
Leucine	6.71	6.60
Isoleucine	3.90	2.80
Tyrosine	2.98	6.30
Phenylalanine	4.21	6.30
Histidine	2.97	1.90
Lysine	3.46	5.80
Threonine	3.58	3.40
Tryptophan	ND	1.10
Non- essential amino acid		
Aspartic acid	11.52	-
Proline	4.25	-
Serine	5.11	-
Glutamic acid	12.97	-
Glycine	4.80	-
Alanine	4.28	-
Arginine	11.29	-
Total Essential amino acids with Histidine (TEAA)	35.69	
Total Essential amino acids without Histidine	32.72	
Total Non-Essential amino acids (TNEAA)	54.22	
Total acidic amino acids (TAAA)	24.49	
Total Basic amino acids (TBAA)	14.16	
Total Sulphur amino acids (TSAA)	3.16	

[a]Data from **FAO/WHO/UNO (1985)** and **FAO/WHO (1991)**; taken from **Zarkadas *et al*. (1995)**   N.D- Not Determined

3.3. Baking quality of formulated biscuits

Table 3 and Fig. 1 illustrate the physical properties (diameter, thickness, spread ratio, and spread factor) of biscuits manufactured with various quantities of (CGJS) lipase flour, and control biscuits made with 100% wheat flour. By increasing the amount of (CGJS) lipase flour replacement, the diameter of the biscuits gradually shrank. T0 (control) biscuit and T1 (2.5 %) biscuit (6.51 and 6.48 cm, respectively) had the most significant ($P< 0.05$) value, whereas T4 (15.0 %) biscuit had the lowest (6.28 cm). The thickness of the biscuits made with (CGJS) flour differed from the control sample significantly ($P > 0.05$), indicating that the thickness of the biscuits was positively influenced. As the percentage of (CGJS) lipase flour substitution increased from T1 (2.5%) to T4 (4.0%), it exhibited a progressive rise (15.0 %). T4 was determined to have the greatest value (0.55 cm) (15.0 %). As the amount of crude fiber and crude protein increased, the thickness increased.

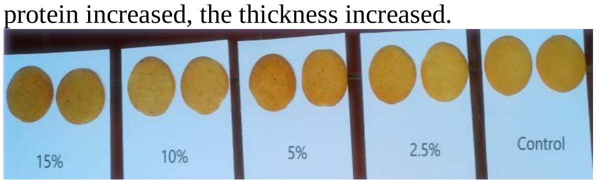

Fig. 1. Image of biscuits made from wheat Flour 100% (BF) and crude germinated Jatropha seed (CGJS) lipase flour percentages

Table 3. Physico-chemical properties and Baking quality of biscuits formulated with different levels of Jatropha seed (CGJS) flour

Treatments	pH value	Color				Diameter (cm)	Thickness (cm)	Spread ratio	Spread factor
		L*	a*	b*	ΔE*				
T0 (Control)	7.06 ^{a} ±0.02	70.78^{a} ±2.35	10.95 ^{a} ±0.91	35.81^{a} ±2.0	45.50^{a} ±2.90	6.51^{a}±0.02	0.50 ^{c} ±0.02	13.06 ^{a} ±3.0	130.60 ^{a} ±2.0
T1 (2.5 %)	6.92^{b}±0.03	69.40^{b} ±3.0	10.48 ^{b} ±0.58	35.24 ^{a} ±3.0	44.52 ^{b} ±2.37	6.48^{ab} ±0.02	0.52 ^{bc} ±0.02	12.46 ^{ab} ±2.0	124.62^{b}±2.0
T2 (5.0 %)	6.77^{c}±0.02	68.79 ^{c} ±4.0	9.16 ^{c} ±2.01	34.03^{b} ±3.0	43.99 ^{c} ±3.0	6.45^{bc}±0.02	0.53 ^{ab} ±0.02	12.17 ^{bc} ±2.0	121.70^{bc} ±3.0
T3 (10.0 %)	6.70 ^{c} ±0.02	66.33^{d} ±2.0	9.04 ^{d} ±0.48	33.21^{bc} ±2.03	43.14 ^{dc} ±3.0	6.43^{c}±0.02	0.54 ^{ab} ±0.02	11.91^{c} ±2.0	119.07 ^{c} ±2.0
T4 (15.0 %)	6.61^{d}±0.02	63.92^{e}±2.26	8.95^{e} ±0.50	32.81^{c}±3.0	41.44^{d}±2.02	6.28^{d}±0.02	0.55 ^{a} ±0.02	11.42 ^{d} ±2.0	114.18 ^{d} ±2.0

All values are means of triplicate determinations ± standard deviation (SD).
Means within columns with different letters are significantly different ($P<0.05$).
L* lightness a* red/green coordinate, b* yellow /blue coordinate, ΔE* total color difference

Bose and Shamsul-Din [42] showed that, addition of chickpea flour to biscuits resulted in reduced diameter of biscuits. Abidum and Ehimen [43] reported that, when sweet potato flour (SPF) and unripen banana flour were added to the batter, the thickness of the biscuits. This might be owing to the use of pigeon pea flour, which increases the protein level (PPF). Table (3) displays the result of biscuits spread ratio which indicated the spread ratio reduction. Spread ratio of T0 (control) biscuits was13.06, after the addition of (CGJS) lipase flour to biscuits, it was decreased to reach 12.46 to 4.42 with T1 (2.5 %) and T4 (15.0 %) (CGJS) lipase flour additives, respectively. The spread ratio is used to determine the quality of used flour to prepare biscuits and ability of biscuits similarly to [44].

Spread ratio of various treated biscuits rapidly reduced as the level of (CGJS) lipase flour increased. These findings are the same as those reported by Bala et al. [45] who found that because protein and dietary fiber and protein have greater water-binding strength than flaxseed flour, the decrease in spread ratio might be attributable to an increase in protein and dietary fiber percentage with an increase in flaxseed flour level. Also, when more water is present, more sugar is dissolved during mixing of dough, furthermore, non-wheat high protein flours retain more water than wheat flour flours so, non-wheat high protein flours are utilized in biscuits [46].

Table 3 and Fig. 1 indicated the average of spread factor values of the biscuits in the sample. The spread factor is a proportion based on thickness and diameter of biscuits. Spread factor dropped when the quantity of (CGJS) lipase flour replacement was raised from 124.62 to 114.18 in (CGJS) lipase flour at 2.5 percent -15.0 percent additive levels, respectively, whereas the control sample had the most significant ($P < 0.05$) value of 130.60 (T0). A similar pattern was noticed by Oyewole et al. [47].

3.4. Physical characteristics of biscuits with Jatropha (CGJS) flour

Results from Table 3 showed that the pH value of the prepared biscuits from different levels of (CGJS) lipase flour significantly varied ($P < 0.05$) within treatments. All pH values showed gradual decrement of the biscuits samples as the increasing level of (CGJS) lipase flour percentages replacement from T1 (2.5 %) to T4 (15.0 %), were ranged from T1 (6.92) to T4 (6.51), comparing to T0 (7.06).

All pH values of biscuit samples (Table 3) were less than 6.0, which was being considered non acidic food product. It is noted that the higher the percentage of addition levels of (CGJS) lipase flour, the more acidic the biscuit as shown in Table (4). The pH was shown to be a significant factor on biscuit texture (crispiness, hardness), as well as flavor [48].

Results of Table 3 shows the color determination of the biscuits, which were differed significantly ($P < 0.05$) among some of the samples. It was discovered that as the amount of partly (CGJS) lipase flour was increased, the L* value rose.

The range of values was 70.78 to 63.92. Addition of the (CGJS) lipase flour was observed to increase the brightness of the biscuits. Values of a* and b* were decreased while increased the fortification of (CGJS) lipase flour. Furthermore, a* value was decreased from 10.95 to 8.95 and b* value was decreased from 35.81 to 32.81. Also, trend of ΔE* (color difference) was decreased gradually by the increment of (CGJS) lipase flour levels. The records of ΔE* for (CGJS) lipase flour concentration of T4 (15.0 %) was 41.44 compared with the control (45.50). The yellowing and whitening as a result of the inclusion of the CGJS lipase flour biscuits might be referred to as discoloration, which could be caused by the baking time, or heat treatment [49]. Damiana et al. (2014) [50] reported that yellowness and redness in biscuits was related to high protein content.

3.5. Sensory evaluation of biscuits prepared form crude germinated Jatropha seed (CGJS) lipase flour

Results from Table 4, summarizes sensory parameters of formulated biscuits samples with different levels of Jatropha seed (CGJS) flour. There were significant differences between the samples and the control biscuits sample ($P < 0.05$). Sensory attributes of taste, color, odor, flavor, texture and overall-acceptability. Results revealed that biscuit with T1 (2.5 %) (CGJS) flour had higher score of all sensory attributes followed by T2 (5.0 %) compared with T0 (control). However, it had higher acceptance value than the T3 and T4 biscuit samples with (CGJS) lipase flour.

Table 4. Sensory evaluation of biscuits formulated with different levels of crude germinated Jatropha seed (CGJS) lipase flour

Treatments	Color	Taste	Odour	Flavour	Texture	Overall-acceptability
T0 (Control)	9.60 [a] ±0. 2	9.70 [a] ±0.2	9.86 [a] ±1.03	9.95 [a] ±1.03	9.68 [a] ±1.00	9.70 [a] ±1.00
T1 (2.5 %)	9.02 [a] ±0.3	8.14 [b] ± 0.3	7.91 [b] ±1.02	7.98 [b] ±1.02	7.97 [b] ±1.02	8.24 [b] ±1.00
T2 (5.0 %)	9.00[a] ±0.2	8.02 [b] ±0.3	7.82 [b] ±1.03	7.92 [b] ±1.00	7.88 [b] ±1.00	8.11[b] ±0.98
T3 (10.0 %)	8.00[b] ±0.3	7.27 [b] ±0.2	7.45 [c] ±1.00	7.85 [c] ±1.00	7.86 [b] ±1.00	7.78 [c] ±1.00
T4 (15.0 %)	6.73[c] ±0.2	5.91[c] ±0.2	6.45[d] ±1.02	5.12[d] ±1.00	6.64 [c] ±0.08	6.18 [d] ±1.00

These findings suggested that the CGJS lipase flour may be added to prepared biscuits at a rate of 15% without impairing their sensory properties. Generally speaking, biscuits with less bitterness were preferred by the panellists. Because of this, the biscuit samples (T0, T1, and T2) scored higher than other biscuits. Due to the phenolics in Jatropha seeds, biscuits may have astringent and bitter flavors [50].

As a result, T1 (2.5%) and T2 (5.0%) percentages of addition of (CGJS) lipase flour for supplemented biscuits may be advised to be created as biscuits with a high protein supplement and good quality acceptable sensory qualities. Therefore, increasing the (CGJS) lipase flour concentration in the combination between 2.5 and 5% has a clear relationship with the high protein content while having no influence on organolyptic quality (flavor, color, and texture). Argüello et al. (2016) [51] studied effect of the Jatropha fortification for increasing protein content of maize tortillas.

4. Conclusions

This study gave new possibilities of utilization of (CGJS) lipase flour and wheat flour, based on the findings and the shortage of high protein foods in many flour-based diets. Incorporating partially crude germinated Jatropha seed (CGJS) lipase flour to biscuit not only provides consumers with the above-mentioned benefits, particularly low calories, but also allows them to consume biscuits that are high in protein, fat, and ash content while still tasting great.

5. Conflicts of interest

There are no conflicts to declare.

6. Formatting of funding sources

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