

Physical, Sensory, And Texture Study On Niger Seed (*Guizotia Abyssinica* Cass.) Flour Fortified Cookies

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Abstract

Niger seed has several health advantages. The Niger seed is used commercially for oil and as bird feed. In this study, we used Niger seed as Whole Niger Seed Flour (WNSF) and Roasted Niger Seed Flour (RNSF) (15%, 30%, and 45%) partially replaced by refined wheat flour in cookies. We examined the effect of fortified on cookies with Niger seed on the physical and sensory characteristics. We prepared two types of cookies sample with different blends, WNSF with blends (C1= 15%, C2= 30%, and C3 =45%) and RNSF with blends (RC1= 15, RC2= 30% and RC3= 45%) with Control sample (C0). In this study, we found that when we prepared cookies sample with (Whole / Roasted flour) simultaneously increasing order; spread ratio, hardness, and color showed increasing order and water absorption content, and gluten showed decreasing order and decreasing sensory attribute with increasing composite flour because of the bitter taste.

Keywords – Physical, Sensory evaluation, Cookies, Niger seed, Whole Niger Seed Flour, Roasted Niger Seed Flour.

1. Introduction

Niger seed (*Guizotia abyssinica* Cass.) is one of the neglected and underutilized plant crops (Getinet & Sharma 1996; Geleta 2013; Sutanuka Hazra 2016; Baranwal 2017). Niger seeds belong to the family member of the “Asteraceae”. It is an important oilseed crop with medicinal properties. Another commonly known name is “Noug in Ethiopia, Black seed in English, and Ramtil, Kalatil in Hindi.” Niger seed is produced mainly in Ethiopia 50% and India 3%. It is an economically important edible oilseed crop in Ethiopia. In Ethiopia, Niger seeds are used in many Ethiopian dishes, condiments, and snacks such as “litlit” or “chibito” which are prepared with crushed Niger seeds and roasted and ground cereals (Getinet & Sharma 1994). Crushed niger seeds with pulses were mixed, making “wot” for young boys (Seeglere 1983; Getinet & Sharma 1994). According to Dutta et al, 1994, Niger oil cake is the leading protein supplement for livestock in Ethiopia. In Western countries, Niger seeds are essential food supplements for birdseed mixtures (Lin, 2005). And the other hand In India, Niger seeds are cultivated in the state of Madhya Pradesh, Orissa, Maharashtra, Bihar, Karnataka, Andhra Pradesh, Uttar Pradesh (Bundelkhand region), Rajasthan, Gujarat, and Tamil Nadu (Getinet & Sharma 1996;). It is used as a spice in dhal, vegetables, and pickles in Indian cuisine. It also used a Niger seed dry chutney powder in South India eaten with bread (Bhagya et, al., 2003; Ramadan 2014; Hazra et, al. 2015). Niger seed is an essential source of edible oil. It plays a significant role in human nutrition and health because

of its fatty acid composition and high fat-soluble bioactive components (Dutta 1994; Ramadan 2012; Jain et al., 2016). High in linoleic acid with polyunsaturated fatty acids (PUFAs) could lower low-density lipoprotein cholesterol without any side effects on high-density lipoprotein cholesterol (Mensink & Katan, 1992). Niger seed is an essential source of plant protein, carbohydrates, vitamins, minerals, and fiber (Thatte and Lakshmi 2012; Mulatu, and Geleta 2013). According to Seeggelar (1983), Ethiopia defatted niger seed meal with less protein and more crude fiber than in Indian-grown seed. According to previous studies, Niger seed has a beneficial therapeutic value in treating certain kinds of disease and microbial infection, burn, cough, contraceptive, arthritis, and syphilis in the Bundelkhand region at the ex-situ level (Sumeet dwivedi 2012). Rao (1994) reported that it could use niger seed oil in rheumatism treatment. In addition, Niger sprouts mixed with garlic are used to treat coughs (Getinet & Teklewold, 1996).

Food fortification is the most popular technique to prevent micronutrient deficiency worldwide. Which improves the nutritional value and enriched some kinds of nutrients in food by incorporating nutritionally rich entities? Fortified process, it also is kept in mind that the food's sensory attributes are not hampered much, or it may not be acceptable to the consumer (Choudhary et al, 2015; Akhtar et al, 2008).

Cookies are the most popular bakery product, easily carried and ready to eat by nature. All age groups consume it. Many studies found fortified cookies with different ingredients (Choudhary et.al, 2015). The purpose of this study was to blend graded levels (0-45%) of whole Niger seed flour (WNSF) and roasted niger seed flour (RNSF) with refined wheat flour and examine the effects of these blends on physical, texture, and sensory attributes.

2. Materials and methods

2.1. Collection of ingredients Niger seed sample was collected from the online store. Other ingredients were collected from the local market of Jhansi.

2.2. Preparation of Niger seed flour

Niger seed is soaked in normal water for 3 hours, and then washed 3-4 times with tap water. After washing, the seeds were dry in a cabinet dryer for 2 hours at 45⁰C temperature. After drying, Niger seeds were divided into two parts. The first was non-roasted, and the second was roasted for 5 min on medium flame. Both are grounded with (Bajaj majesty mixer) grinder in the food technology department at Bundelkhand University, Jhansi. Composted flour was prepared by blending refined flour with whole Niger seed flour (WNSF) in different ratios (100:0%, 85:15%, 70:30%, and 55:45%), and refined flour with roasted Niger seed flour (RNSF) in different ratios (100:0%, 85:15%, 70:30%, and 55:45%).

2.3. Preparation of cookies

In this study, the basic ingredients were used refined wheat flour 100gm, sugar 50gm, shortening 50gm, baking powder 1.0gm, baking soda 0.5gm, vanilla essence 2ml, and water as required. The sample was made with 0%, 15%, 30%, 45%, WNSF, and RNSF (Table-1). Shortening and sugar are mixed thoroughly in a bowl together until a soft and spongy texture is formed (Bajaj majesty) hand blender for 5 min at 3 speeds. The dry ingredients were weighed and mixed with shortening and prepared in different ratios of dough and prepared dough rest for 15 min in the refrigerator. Take a small ball of dough and place it in a greased baking tray and bake for 20-25 min at 160⁰C at Bajaj majesty OTG oven, then after baked cookies allow cooling, and packed in zip lock bags for further analysis.

Table.1 cookies ratio –

S. No.	Flour (gm)	NSF (gm)	Sugar (gm)	Butter (gm)
Whole/ roasted				
C0	100	0	50	50
C1	85	15	50	50
C2	70	30	50	50
C3	55	45	50	50
RC1	85	15	50	50
RC2	70	30	50	50
RC3	55	45	50	50

Abbreviations NSF- Niger Seed Flour, C-Control, C1- Whole Niger Seed Cookies 15%, C2-Whole Niger Seed Cookies 30%, C3- Whole Niger Seed Cookies 45% and RC1- Roasted Niger Seed Cookies 15%, RC2- Roasted Niger Seed Cookies 30%, RC3- Roasted Niger Seed Cookies 45%.

3. Physical analysis

These analyses of cookies were determined with the moisture, spread ratio, water absorption capacity, and gluten.

3.1. Moisture parameters were evaluated by AOAC methods 2000, by using a hot air oven (Manufactured by Jyoti scientific). All cookies grounded with mortal pastel, take 3 gm sample in a Petri dish into a hot air oven for 3 hours at 110°C temperature. Moisture content was calculated by the following equation (AOAC 2000).

$$\text{Moisture \%} = (W1-W2/ W1) \times 100 \dots \dots \dots (1)$$

Where W1 = weight (g) of sample before drying, W2 = weight (g) of sample after drying.

3.2. Diameter and Thickness Diameter (D) of biscuits was measured by laying four biscuits edge-to-edge with the help of a scale. The same set of biscuits was rotated 90° and the diameter was re-measured. The average values of these biscuits are reported in centimeters. The thickness (T) of biscuits was measured by stacking four biscuits on top of one another and taking the average of four biscuits per centimeter. The cookies spread ratio was determined by diameter and thickness, using the Vanier calipers, and the following equation (s.s Umesh, 2014)

$$\text{Spread ratio} = D/T \dots\dots\dots (2)$$

Where D = diameter and T = thickness.

3.3. Water absorption capacity 10-gram flour was taken from each batch (one was control and six samples with different ratios with control, containing whole Niger seed flour (100:0%, 85:15%, 70:30%, and 55:45%) and (100:0%, 85:15%, 70:30%, and 55:45%) contain roasted Niger seed flour in a beaker. Water was added drop by drop in flour from each batch, constantly stirring until the dough was prepared. The amount of water added to the dough was noted, and WAC for each batch was calculated by the formula (Siddaraju et al. 2008, Choudhury 2015).

$$\text{WAC (\%)} = [\text{Amount of water used (g)} / \text{weight of dry flour (g)}] \times 100 \dots\dots (3)$$

3.4. The gluten content of 10-gram flour was taken for each batch by adding sufficient water. Prepared dough and standing in water for an hour. Then each dough sample was washed in the running water to squeeze off the starch. Washing was done until squeezed water turned clear. After washing, the remaining dough was dried in a hot air oven at 100 °C for 1 hour. The weight of dried gluten was taken, and gluten content was calculated by the following equation (AACC 2000; Pedersen and Jorgensen 2007; Choudhury 2015).

$$\text{Gluten content \%} = [\text{Weight of gluten (g)} / \text{weight of flour (g)}] \times 100 \dots\dots (4)$$

3.5. Texture Analyzer Texture analyzer (TA-XT2 plus, surrey, U.K.). An aluminum compression platen probe was used in a texture profile following.

- Pre-test speed – 1.0 mm/s
- Test speed – 1.0 mm/s
- Past speed – 5 mm/s
- Time – 5 sec
- Distance – 5mm.
- Probe – P 75

4. Sensory evaluation of cookies All cookies were prepared for sensory parameters such as texture, appearance, taste, flavor, and overall acceptability using a nine-point hedonic scale with ten semi-trained panelists (Food technology staff) from the food science and technology department Bundelkhand University, Jhansi. The panelist was familiar with the cookies since childhood. The score was based on a nine-point hedonic scale (like extremely -9, like moderate – 7-8, like slightly – 5-6, dislike slightly – 3-4, dislike moderate – 1-2, dislike extremely – 0) the training session was held on until the panelists were trained to sensory attributes, ten panelists were trained by the researcher using standard product evaluation criteria (Ranganna,1986). The randomly three coded samples were served to the panelists individually. The panelists were offered cookies with plain drinking water for cleansing the palate between samples to avoid mixing tastes.

5. Statistical analysis

All analyses were triplicate and sensory data was evaluated with ten replicates. Data reported were Mean \pm S.D values were calculated. Every analysis was calculated with one-way ANOVA and was performed with IBM SPSS Statistics software version 22. In this present study a significant difference in mean values on a significance level of ($p \leq 0.05$).

6. Results and discussion

6.0- The moisture content of niger seed flour cookies decreased with 0-45% of WNSF and RNSF flour results shown in (Table-2) with a range between (4.02 ± 0.01 - 2.82 ± 0.01) as the amount of niger seed flour increased from 0- 45% moisture content significantly ($p < 0.05$) decreased. We found a similar study in flax seed cookies (Kour 2017; Khouyieh & Arammouni 2012).

Table no. 2 thickness, diameter, spread ratio, moisture of cookies and WAC and gluten of composite flour.

Table no. 2 The Physical Parameters of Cookies and Composite flour-

Sample	Cookies				Flour	
	Thickness (cm)	Diameter (cm)	Spread ratio (D/T)	Moisture% (cookies)	WAC% (flour)	Gluten% (flour)
C ₀	1.32 \pm 0.119 ^{bc}	3.55 \pm 0.053 ^d	2.7 \pm 0.243 ^{bc}	4.02 \pm 0.01	40.0 \pm 0.0	12.0 \pm 0.0
C ₁	1.91 \pm 0.196 ^a	3.99 \pm 0.068 ^c	2.12 \pm 0.265 ^c	4.0 \pm 0	37.0 \pm 0	11.0 \pm 0
C ₂	1.31 \pm 0.321 ^{bc}	4.01 \pm 0.088 ^c	3.19 \pm 0.742 ^{ab}	3.85 \pm 0.01	31.97 \pm 0.06	10.2 \pm 0
C ₃	1.12 \pm 0.126 ^c	4.02 \pm 0.091 ^c	3.61 \pm 0.35 ^{ab}	2.67 \pm 0.58	29.97 \pm 0.06	8.6 \pm 0
C ₄	1.5 \pm 0.168 ^b	4.02 \pm 0.091 ^c	2.99 \pm 0.578 ^{abc}	2.86 \pm 0.01	30.0 \pm 0.0	10.0 \pm 0.0
C ₅	1.42 \pm 0.09 ^b	4.36 \pm 0.185 ^b	3.08 \pm 0.309 ^{abc}	2.84 \pm 0.01	26.97 \pm 0.06	9.5 \pm 0.0

C ₆	1.28±0.075 ^{bc}	4.75±0.089 ^a	3.73±0.245 ^a	2.82±0.01	22.0±0.0	7.0±0.0
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The all values are mean ± SD of three replicates.

^{abcd} means with different superscripts in the same columns indicate significant difference ($p \leq 0.05$) post hoc test.

6.1. Water absorption capacity for all the seven types of dough samples, one was control and the other six were fortified with WNSF and RNSF with different ratios (100:0%, 85:15%, 70:30%, and 55:45%), calculated as shown in Table 2. Results show that increase the level of fortified flour water absorption capacity also decreased. In general amount of Niger, seed flour increased from 0% to 45% in cookies, both sample (WNSF and RNSF) water absorption capacities decreased due to the gluten content of refined wheat flour restricted the water and fiber interaction and the dough become more hydrophobic as a result, the dough absorbed less water. Which is present in Niger seed fortified flour (0-45%) both (WNSF and RNSF) decreased the value compared with control flour Saeed (2009); but the above result is contradicted by a study of flaxseed water absorption is increased with increased roasted flax seed flour level an increase water absorption activity Pandurang & Arya (2014); Choudhary (2015).

6.2. Gluten content results of all seven types of samples are given in Table 2. Results were seen that gluten content was decreased with the increase in the level of fortification. Maybe this is the reason of replacement of wheat flour with Niger seed flour has led to the reduction of gluten levels in the fortified samples. Previous studies report that this effect is attributed to protein, fiber, and a low amount of gluten which interferes with a decrease in gas retention capacity. Similar results were also found in Gomez (2003), Choudhary (2015) study on bamboo shoot powder.

6.3. Spread ratio cookies spread factor represented a ratio of the diameter to thickness. A good quality cookie has a high spread ratio. The effect of the addition of niger seed flour on height, diameter, and spread ratio is shown in Table.2. The cookie height significantly decreases with a high level of niger seed in the cookie. It is possibly a reason for inhibition of gluten development by the high-fat content from the niger seed flour thus causing less air entrapment. Taylor reports that gluten development contributes to an expansion in the height of baked products but cookies do not increase dramatically in height, because sugar attracts water over the gluten protein fat has also been shown to prevent excessive development of the gluten network during mixing. The cookie spread ratio diameter increases with the addition of the high level of niger seed. Previous studies report that cookies made with soft wheat flour were significantly larger in diameter than those made with hard wheat flour (miller and Hoseney 2012; Khouryieh and Arramouni 2012). A similar previous study showed that the replacement of wheat flour with flaxseed flour significantly increases the value of the cookie spread ratio. This is possible due to the lack of gluten and the high-fat content of flaxseed. The high-fat content of the seed might have increased the mobility in the system that occurs when the fat melts, during baking, thus producing a higher spread ratio. Similar results were found with flaxseed flour-fortified cookies in many studies (Khouryieh 2012; Ganorkar 2014; Yogesh gut 2017).

6.4. Texture analysis results are presented in Table.3. Hardness, springiness, cohesiveness, gumminess, chewiness, and resilience increased with the level of fortified niger seed flour in the cookie. According to Hanna Khouryieh, et. al., (2012); Kour et.al., (2019); cookie hardness increased as the level of niger seed flour increased in cookies. The increase in the hardness of the cookies can be attributed to the high protein content in the flaxseed flour. Ganorkar et. al., (2014) reported in their study that the incorporation of flaxseed flour increased hardness. Fustier et al., (2009)

reported that cookie hardness increased with protein content from flour. So the present study on Niger seed cookies also increases the hardness with a higher level of Niger seed flour.

Table.3. Texture Analysis of Prepared Cookies –

Sample	Characteristics*						
	Hardness (g)	Adhesiveness (g.sec)	Springiness	Cohesiveness	Gumminess	Chewiness	Resilience
C ₀	66187±32986	-43.3±9.6	0.073±0.012	0.05±0	3786±1243	431±108	0.03±0.03
C ₁	78118±9780	-75.6±3.6	0.167±0.006	0.083±0.006	7405±1230	1937±124	0.033±0.033
C ₂	95886±5129	-152±27	0.167±0.021	0.097±0.0	11594±1628	2421±548	0.033±0.033
C ₃	178441±13151	-178.9±1.8	0.18±0.01	0.11±0	15730±1433	3643±553	0.067±0.067
C ₄	29983±1689	-18.3±1.1	0.113±0.006	0.027±0.006	723±126	144±18	0.01±0.01
C ₅	45041±1002	-43.6±17.6	0.117±0.006	0.047±0.006	723±126	277±6	0.013±0.013
C ₆	70973±3669	-46.4±7.5	0.22±0.02	0.777±0.045	4671±671	604±66	0.023±0.023

All values are mean ± SD of three replicates.

*Significance deference value on (p≤0.05).

7. Sensory analysis of all seven types of cookie sensory evaluation means data represent in Table no.4. Results of Niger seed fortified cookies present that color, flavor, texture, taste, and overall acceptability were affected by increased Niger seed flour concentration. Compared to the control sample. Control cookies with the experimental cookies are significantly (p<0.05) decreased. The overall acceptability of the C1 and RC2 samples significantly increased with the control sample. Significantly (p<0.05) reduced color acceptability in C1, C2, C3 and RC1, RC2, and RC3 because of its appearance due to its black color. Taste and flavor also decrease due to their bitter taste and pungent aroma. Other seed studies showed that increasing the ratio of seed flour decreased the acceptability of food because of seed flavor and color. due to high temperature, the seed phenolic compound change the darker color (Ganorkar and Jain 2014; Khouryieh and Aramouni 2012) studies show that the decreased appearance and color attributes indicated that the higher seed levels led to darker color possibly due to the Maillard reaction in flaxseed.

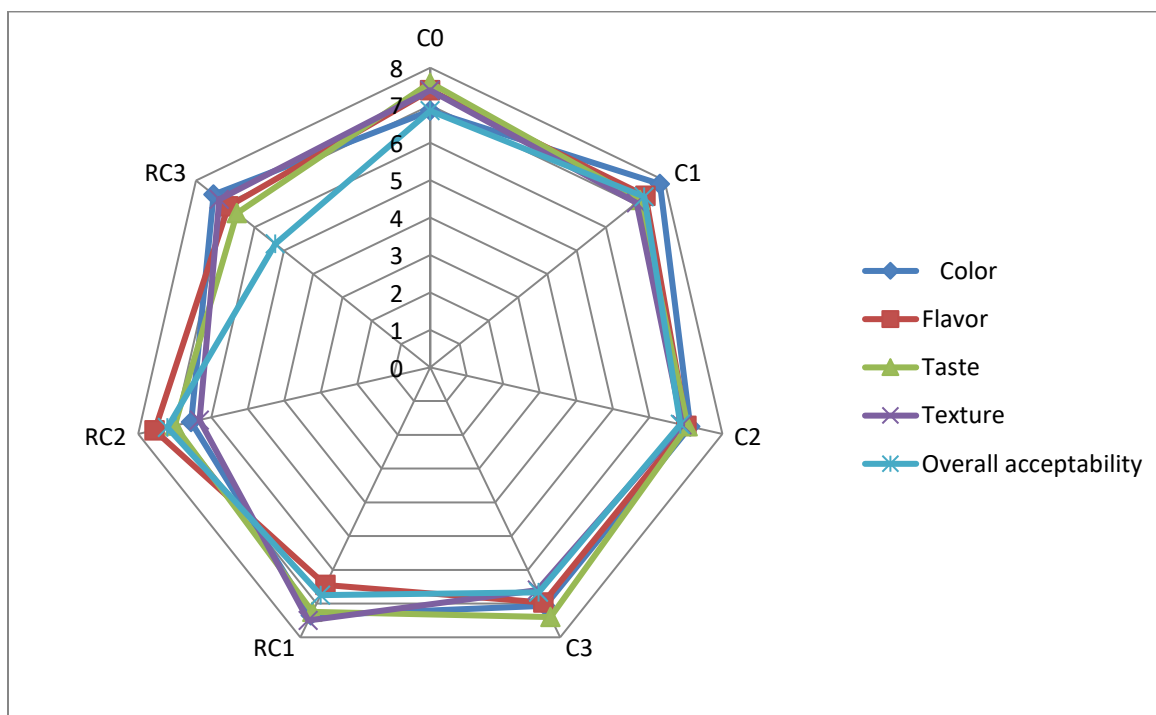
Table.4. Sensory characteristic of cookies prepared from blended flour -

Sample	Color	Flavor	Taste	Texture	Overall acceptability
C ₀	6.85 ^{ab} ±1.15	7.4 ^a ±0.65	7.6 ^a ±0.45	7.4 ^a ±1.17	6.85 ^{ab} ±1.97

C ₁	7.85 ^a ±0.78	7.35 ^a ±0.31	7.17 ^{ab} ±0.50	7.05 ^a ±0.64	7.31 ^a ±0.29
C ₂	7.12 ^{ab} ±0.93	7.02 ^{ab} ±0.18	7.05 ^{bc} ±0.36	6.90 ^a ±0.80	6.85 ^{ab} ±0.74
C ₃	7.07 ^{ab} ±1.11	6.97 ^{ab} ±0.44	7.4 ^c ±0.56	6.60 ^a ±1.10	6.67 ^{ab} ±1.13
C ₄	7.35 ^{ab} ±0.47	6.45 ^b ±0.64	7.0 ^{abc} ±0.16	7.5 ^a ±0.57	6.75 ^{ab} ±0.70
C ₅	6.55 ^{ab} ±0.83	7.55 ^a ±0.14	7.25 ^{abc} ±0.50	6.32 ^a ±1.06	7.2 ^a ±0.68
C ₆	7.4 ^{ab} ±0.51	6.9 ^{ab} ±0.39	6.6 ^{ab} ±0.45	7.2 ^a ±0.63	5.29 ^b ±1.56

*The all values are mean ± SD of three replicates.

^{abc} means with different superscripts in the same columns indicate differ significant difference ($p \leq 0.05$) post hoc test.



*Figure 1 Roder chart of whole and roasted niger seed flour cookies.

8. Conclusion The results of this present study show that increasing the amount of Niger seed flour in both conditions (WNSF & RNSF) with different ratios (15%, 30%, and 45%) significantly decreases the water absorption capacity because it indicates that niger seed flour did not retain moisture in both conditions (WNSF & RNSF), gluten content in sample flour decrease with the high amount of niger seed in both forms, due to protein, and fiber level in niger seed flour barrier in air retention in flour. In the physical study of cookies are decreased thickness, increased diameter, and spread ratio because of the low amount of gluten in experimental cookies flour and the high amount of fat in experimental cookies, and hardness of cookies with different attributes like chewiness, cohesiveness, resilience, gumminess, springiness increase because of protein, fiber and fat oil which present in niger seed. The sensory result shows that the different attributes decrease with increases in the level of niger seed. We can see the significant difference in cookie color, flavor, texture, taste, and overall acceptability. The sensory result indicates that the low to moderate percentage of nigger seed cookies were most preferred among the panelist. While the high level of niger seed cookies has a negative effect on all sensory attributes.

Declaration and competing for interest

The authors have affiliation with an organization and have no organization with a direct or indirect financial interest in the subject matter discussed in the manuscripts.

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