HILL PUBLISHING

International Journal of Food Science and Agriculture, 2024, 8(3), 100-111
https://www. hillpublisher. com/journals/jsfa/
ISSN Online: 2578-3475
ISSN Print: 2578-3467

Technological Aptitude and Acceptability of Four Sesame Varieties from Burkina Faso in Pastes and Biscuits

Rasmata Dabo[1,*], Edwige Bahanla Oboulbiga[1], Zénabou Semde[1], Hyacinte Kanté-Traoré[1], Olivier Banhoro[1], Diarra Compaoré-Sérémé[1], Sinaly Diarra[1], Zoénabo Douamba[1], Barakissa Ouédraogo[2], Fidèle Wend-bénédo Tapsoba[1], Fatoumata Hama-Ba[1]

[1]Food Technology Department, Institute for Research in Applied Sciences and Technologies, National Center for Scientific and Technological Research, 03 BP 7047 Ouagadougou, Burkina Faso.
[2]High Institute of Technology, 03 BP 7047 Ouagadougou, Burkina Faso.

How to cite this paper: Rasmata Dabo, Edwige Bahanla Oboulbiga, Zénabou Semde, Hyacinte Kanté-Traoré, Olivier Banhoro, Diarra Compaoré-Sérémé, Sinaly Diarra, Zoénabo Douamba, Barakissa Ouédraogo, Fidèle Wend-bénédo Tapsoba, Fatoumata Hama-Ba. (2024). Technological Aptitude and Acceptability of Four Sesame Varieties from Burkina Faso in Pastes and Biscuits. *International Journal of Food Science and Agriculture*, 8(3), 100-111.
DOI: 10.26855/ijfsa.2024.09.003

Received: July 10, 2024
Accepted: August 7, 2024
Published: September 5, 2024

Corresponding author: Rasmata Dabo, Food Technology Department, Institute for Research in Applied Sciences and Technologies, National Center for Scientific and Technological Research, 03 BP 7047 Ouagadougou, Burkina Faso.

Abstract

Sesame is a local product with a high lipid content that is underutilized in Burkina Faso. There is a growing shortage of value-added products throughout the value chain. The aim of this study was to determine the physicochemical characteristics and acceptability of four sesame varieties from Burkina Faso. Pastes and biscuits were produced from these four sesame varieties, and sensory tests were conducted. The moisture, lipid, and fatty acid content of the sesame pastes and biscuits were measured using standard methods. The results indicated that the moisture content of the pastes and biscuits from the four varieties was low, ranging from 1.37% to 2.64% for the pastes and 2.40% to 5.65% for the biscuits. These values align with the recommended standards for sesame pastes (below 8%) and biscuits (below 5%), with the exception of the pakrésaaya biscuits. The fatty acid content of all pastes and biscuits, except for the pakrésaaya biscuits, was below 1.5%, complying with Codex Alimentarius standards. The pastes and biscuits exhibited high lipid contents, varying between 49.10% and 53.39% for the pastes and 20.87% to 22.37% for the biscuits. The sesame pastes, which were highly appreciated initially, produced biscuits that were also well-received by tasters. Among the varieties, the sesame pastes and biscuits from the Wollega and Humera varieties were the most popular.

Keywords

Varieties; sesame; technological aptitude; acceptability

1. Introduction

Sesame (*Sesamum Indicum*) is an oilseed and an excellent food with a high lipid value. Its lipid content has a profile of unsaturated fatty acids (ω-3 and ω-6) containing 38.84% oleic acid and 46.26% linoleic acid, as well as phytochemical antioxidants [1]. In fact, it is one of the healthiest oils, stabilising and reducing cholesterol levels and therefore reducing the risk of cardiovascular accidents. The lipids in sesame seeds also have anti-lipolytic effects on the body and can prevent oxidation of the low-density lipoprotein (LDL) complex with cholesterol. Lignans such as sesamin, sesamol and sesamolin, as well as phytosterols, are also present in sesame oil [2]. Sesamin and sesamolin have numerous health benefits, including anti-inflammatory, antioxidant, cholesterol-lowering, neuroprotective and antihypertensive activities [3]. Sesame oil is stable to oxidation and resistant to rancidity due to its high vitamin E and lignan content and can be stored for a long time [4, 5]. As well as being predominantly fatty, sesame is very rich in fibre (insoluble (60%) and soluble (40%)) and is a valuable aid in boosting sluggish bowel movements [6]. It helps to combat constipation by increasing the volume of stools. It is also rich in calcium, magnesium, phosphorus, potassium, iron and zinc, as well as vitamins and vitamin B (B1 and B6, B2, B3, B9) [6]. Burkina Faso is one of Africa's leading sesame producers. According to the latest statistics, Burkina Faso reached its peak production in 2020, which was 384.614 tonnes, representing 4.4% of the world's sesame production and ranking it 8th in the world [7]. Sesame processing is negligible and remains essentially small-scale and semi-industrial in Burkina Faso. The artisanal form is best known through by products such as paste used as a condiment and/or for oil extraction, and croquettes (cakes) made from a mixture of sesame seeds and sugar or salt [8]. However, sesame is also used in bakery products and as a paste for household sauces. The quantities processed locally do not exceed 50 tonnes, i.e. less than 1% of production in 2012 [9]. Most of the sesame produced in Burkina is cleaned and exported [9]. Sesame can be used to make biscuits. Biscuits are one of the most widely consumed cereal foods in the world [10]. Given its high-fat content, sesame can replace margarine in the biscuit production process. This paste can also be exported to Asia, the Middle East, and Europe. Demand for sesame paste is focused on the following criteria: oil content of the seeds (51% max), fatty acidity of the seeds (less than 1.5%), and foreign body content (less than 2%). The presence of sesame in mass-market products such as biscuits could help reduce certain chronic diseases such as diabetes, cancer and cardiovascular disease, as well as preventing premature ageing and alleviating memory problems, oxidative stress and neurodegeneration in Alzheimer's patients [11, 12]. In Burkina Faso, several sesame varieties are grown and listed in the catalogue [13]. Four sesame varieties (S42, Humera, Wollega, and pakrésaaya) listed in the Burkina Faso seed catalogue were used as pastes in the formulation of biscuits. The objective of this study was to determine the physicochemical parameters as well as the level of acceptability of four sesame varieties through pastes and biscuits.

2. Materials and Methods

2.1 Study site

The pretreatment of the raw material, the production of paste and biscuits, the physico-chemical of samples, and taste analyses of pastes and biscuits were carried out at the Department of Food Technology of the Institute for Research in Applied Science and Technology in Ouagadougou, Burkina Faso.

2.2 Vegetable material

The vegetal material for the study consisted of grains of four white varieties of sesame and one white variety of sorghum. The sesame varieties consisted of S42, humera, wollega, and pakrésaaaya. These were obtained from The Institute for the Environment and Agricultural Research in Ouagadougou, Burkina Faso

Sorghum varieties was Kapelga. It was obtained from producers in Kaya Burkina Faso. The ingredients were purchased from a supermarket in Ouagadougou. They consisted of sugar powder, milk powder, eggs, baking powder, vanilla sugar, and salt. The choice of sorghum and the four varieties of sesame was justified by the ease with which they are available in Burkina Faso in all seasons. The four varieties of sesame are shown in Figure 1.

Figure 1. Photograph of four varieties of sesame.

2.3 Method of processing sesame seeds into sesame paste

The seeds were cleaned to remove impurities, cleaned, washed, dehulled, and wrung out. The seeds were then shelled using a mortar and dried in the sun for one day (09 hours). After drying, the seeds were winnowed, washed, dehulled, and dried. The seeds were then roasted at 132°C for five minutes using a roasting machine and then grinded to obtain the paste. Figure 2 shows some photographs taken during the preparation of the paste.

Figure 2. Sesame paste production operations.

2.4 Sorghum pre-treatment process

The grains were cleaned of impurities, winnowed, washed, dehulled, and dewatered in a basket. After dewatering, the grains were dried in the sun and ground using a hammer mill. The flour obtained was dried for 1 to 2 hours at room temperature and then sieved using a 200 µm mesh sieve to obtain a very fine grain size. The flours were packaged in plastic bags sealed with a heat sealer and stored in plastic drums until use.

2.5 Biscuit production method

The biscuits were produced following the sorghum biscuit production process developed in the DTA laboratory by Songré-Ouattara and his colleagues [14]. Margarine was replaced by sesame paste in the biscuit production diagram. This process includes the following main steps: Weighing of raw materials and ingredients, progressive mixing-kneading of ingredients according to the order of the recipe, shaping of dough pieces, baking of dough pieces, cooling and packaging. The dough was prepared by premixing sorghum flour (34.50%) with milk powder (3.45%), baking powder (0.55%) and sesame paste (34.50%). The caster sugar (13.80%), salt (0.06%), vanilla sugar (0.69%) and eggs (12.42%) were mixed in the mixer for about 3 to 5 minutes, then the premix (sorghum flour, caster milk, baking powder, sesame paste) was gradually added. These pre-mixing stages were carried out to obtain homogenous biscuits. The dough was kneaded for 10 to 16 minutes to obtain a firm, tender dough. After kneading, the dough was rolled out on a cutting table using a rolling pin. The dough was then cut out using cookie cutters. After cutting, the dough pieces were placed on trays and placed in an oven preheated to 140-150°C to bake for 20 to 30 minutes. Once out of the oven, the biscuits were cooled to room temperature in the production room before being packaged. After cooling (approximately 30 to 40 minutes after removal from the oven), the biscuits were packed in polypropylene (plastic) bags and then sealed with a heat sealer. Figure 3 shows some photographs taken during the preparation of the biscuit.

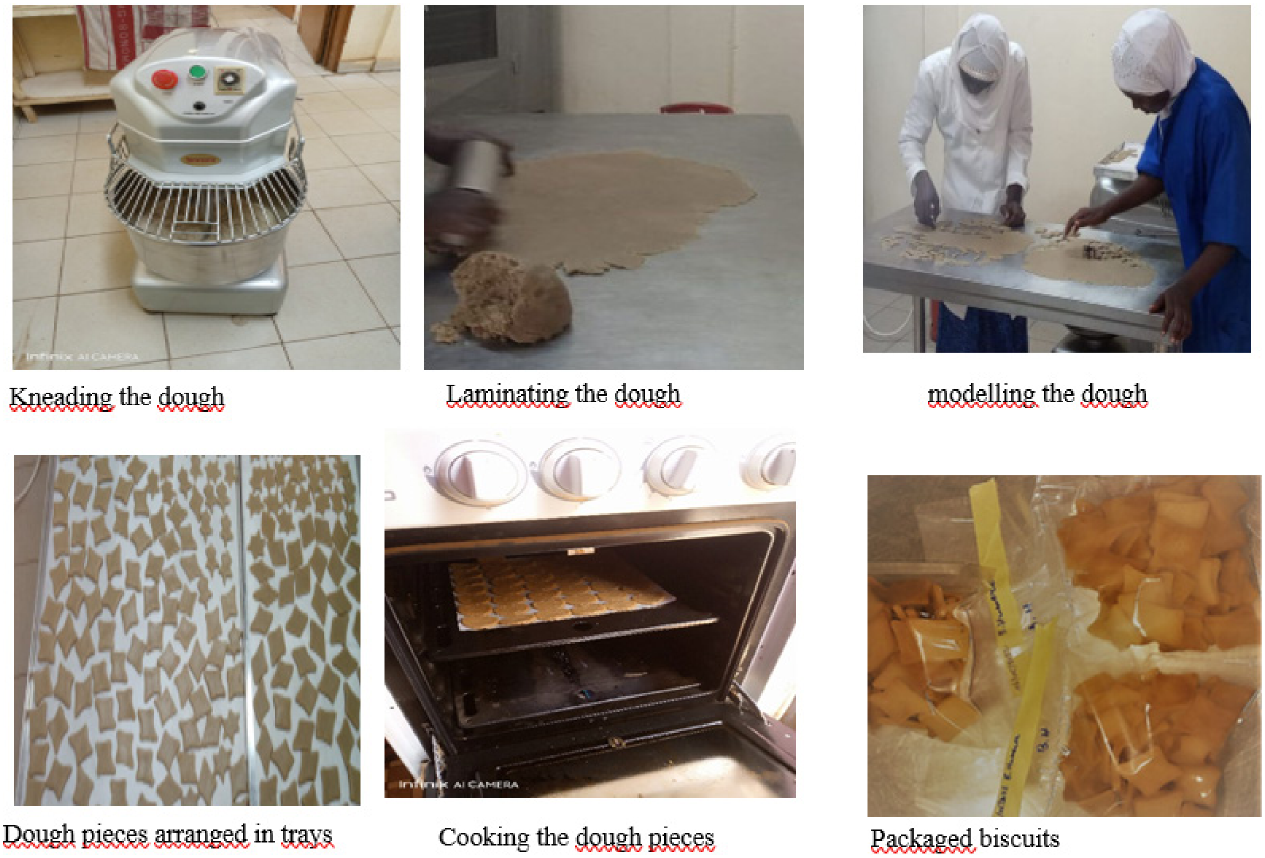

Figure 3. Image of some of the stages in biscuit production.

2.6 Physicochemical analysis of pastes and biscuits

The physicochemical analysis of the pastes and biscuits consisted of determining the moisture, the lipid content, and the fatty acid content. These parameters were determined using the AOAC method in triplicate [15].

The moisture content of the samples was determined by differential weighing before and after oven drying at 105°C overnight in accordance with the French standard [16]

The lipid content of the samples was determined using the Soxhlet extraction method in accordance with the international standard with hexane as the solvent [17].

The fatty acidity of the samples was determined by extraction of free fatty acids using 95% ethanol at ambient laboratory temperature in accordance with the French standard, followed by titration with N/9 sodium hydroxide solution. The results were expressed as g of H2SO4 per 100 g of product [18].

2.7 Sensory analysis of sesame pastes and biscuits

Two panels were used to taste the paste and biscuit samples.

The 1st panel of 34 tasters made up of 76% aged between 15 and 30 years, 18% aged between 31 and 40 years, and 6% aged over 40 years were recruited on the basis of their availability to carry out a series of tests on sesame pastes. The four coded paste samples were presented simultaneously to each panellist in randomised order.

The description of the sensory profile of each paste was based on the aspect of colour ("nice", "fairly nice" and "not nice"), taste ("pleasant", "fairly pleasant" and "not pleasant"), aroma ("good", "fairly good" and "not good"), texture ("fine, granular, fairly fine), viscosity (concentrated, moderately concentrated, slightly concentrated), stickiness (sticky, moderately sticky, not sticky), and smoothness (oily, moderately oily, not oily).

The 2nd panel of 35 tasters comprised 76% aged 15 to 30 years, 14% aged between 31 and 40 years and 10% aged over 40 years. The tasters were recruited on the basis of their availability to carry out a series of tests on sesame biscuits. The four coded biscuit samples were presented simultaneously to each panellist in randomised order.

The description of the sensory profile of each biscuit was based on the aspect of colour (beautiful, fairly beautiful, and not beautiful), aftertaste (pleasant, fairly pleasant, and not pleasant), aroma (good, fairly good, and not good), texture (crisp, fairly crisp, not crisp), hardness (hard, neither hard nor crumbly, crumbly), tenderness (tender, fairly tender, not tender) and appearance (homogeneous, neither homogeneous nor heterogeneous, heterogeneous).

The hedonic test of the two panels consisted of scoring on a five-point scale. The number 5 is assigned to a very pleasant product. The number 4 corresponds to a pleasant product, and the number 3 to a product that is neither pleasant nor unpleasant. 2 is an unpleasant product. The number 1 corresponds to a very unpleasant product. The ranking test in the two panels therefore consisted of ranking the samples in order of preference. The most preferred sample was ranked 1, the most preferred sample was ranked 4, and the rest were given the same rank, without giving the same rank to the two samples.

2.8 Statistical analysis

The data were collected using Microsoft Excel 2019. Analysis of variance (ANOVA) was performed using XLSTAT 2016.02.27444 to study the degree of difference between the variables. In the event of a significant difference between the parameters studied, the classification of the means (homogeneous groups) was carried out using Tukey's test at a significance level (α) of 0.05. Statistical differences with a probability value of less than 0.05 were considered significant. All analyses were performed in three replicates.

3. Results and Discussion

3.1 Physicochemical characteristics of sesame pastes and biscuits

The physicochemical characteristics of the pastes and biscuits of the different sesame varieties are shown in Table 1.

Table 1. Physicochemical characteristics of sesame pastes and biscuits

Sample	Paste			Biscuit		
	Moisture (%)	Lipids (%)	Fatty Acidity (%)	Moisture (%)	Lipids (%	Fatty Acidity (%)
Pakrésaaya	2.64±0.16 c	52.19 ±2.68a	5,40±0,06a	4.05± 0.05b	22.37 ±4.06b	1,51±0,06b
Humera	1.74± 0.12^{d}	49.10± 6.82^{a}	1,37±0,06^{b}	2.84 ±0.23^{c}	20.87 ±0.12^{b}	0,53±0,06^{c}
S42	1.56± 0.01^{d}	48.86± 3.42^{a}	1,21±0,06^{b}	5.65 ±0.1^{a}	21.37 ± 0.81^{b}	0,61±0,06^{c}
Wollega	1.37±0.05^{d}	53.393± 0.76^{a}	1,34±0,06^{b}	2.40± 0.06^{c}	21.574± 1.20^{b}	0,65±0,06^{c}

Note. Values with the same letter (a, b, or c as exponent) in the same column are not significantly different at $p<0.05$.

The moisture of the pastes and biscuits of the different sesame varieties ranged from 1.37% to 2.64% and 2.40% to 5.65% respectively, and were significantly different ($p<0.05$). The highest moisture in paste and biscuits was observed in the pakrésaaya and S42 varieties respectively. The lowest was found in the wollega varieties. These levels are below 5% (except for the S42 biscuit) and comply with the standards for paste [19] and biscuits [20]. The moisture of the S42 biscuits was above the 5% maximum suggested by Zydembos to ensure long shelf life [21]. The low moisture of the paste can be explained by roasting, which removes more of the sesame water, and the low content of the biscuits can be explained by baking, which removes more of the water from the finished product. The moisture of the biscuits was higher than that of the dough. The excess water in the biscuits is certainly due to the other ingredients used in their production. The moisture contents of the different biscuits agree with those found by Songré-Ouattara and his team who found that sorghum biscuits enriched with moringa and spirulina ranged from 2.7% to 5.5% [22].

The lipids of the paste and biscuits were 49.10% to 53.93% and 20.87% to 22.37% respectively, and these contents were not significantly different. The lipids in the biscuits were higher than those of Songré-Ouattara and his collaborators in sorghum-based biscuits with a value of 20.4% and of Hama and collaborators in millet-based biscuits with a value of 20.15% [22, 23]. The fatty acidities of the paste and biscuits varied respectively from 1.21% to 5.40% and from 0.53% to 1.51% and were significantly different ($p<0.05$). These fatty acid contents, except for that of the pakrésaaya paste, are in line with the value of the fatty acid standard for sesame pastes set by the private sector at the farm level, which is 1.5% [24]. These results are subject to long storage. The fatty acidity content of the paste of the different sesame varieties is much higher than that of the biscuits. The fatty acidity of the biscuits of the different varieties is higher than that found by Goubgou and his collaborators on sorghum-based biscuits, which was between 0.02 and 0.03 g H2SO4/100 g biscuit. The high-fat acidity content is related to the fat content of the biscuits [25].

3.2 Consumer test of sesame pastes and biscuits

Table 2 shows the results of Tukey's test of the tasters' responses according to age.

Table 2. Tukey's test of taster responses by gender

	Paste				Biscuit			
Age of participants	Humera	S42	Pakrésaaya	Wollega	Humera	S42	Pakrésaaya	Wollega
>40 years	4.00±0.00[a]	3.00±0.00[a]	3.00±0.00[a]	4.00±0.00[a]	4.67±0.58[a]	3.67±0.58[a]	3.33±0.58[a]	3.67±1.53[a]
31- 40 years	3.71±1.00[a]	3.89±0.96[a]	2.04±0.50[a]	2.21±1.50[a]	4.33±1.21[a]	3.50±0.84[a]	2.83±0.75[a]	4.50±0.55[a]
15-30 years	3.50±0.90[a]	3.75±0.96[a]	2.25±0.79[a]	3.25±1.40[a]	4.38±0.67[a]	3.43±0.98a	2.57±0.98[a]	4.38±0.67[a]
Pr > F	0.857	0.645	0.434	0.215	0.822	0.913	0.385	0.268
Significant	No	No	No	No	No	No	No	No

Note. Values with the same letter (a, b, or c as exponent) in the same column are not significantly different at $p<0.05$.

Paste received average scores according to consumer age, ranging from 3.50 to 4.00 points for the humera varieties, 3.00 to 3.89 points for the S42 varieties, 2.04 to 3.00 points for the pakrésaaya varieties and 4.33 to 4.60 points for the wollega varieties. The biscuits received scores of 4.33 to 4.67 points, 3.3 to 3.67 points, 2.57 to 3.33 points and 3.67 to 4.50 points respectively for the humera, S42, Pakrésaaya and Wollega varieties. The statistical results show that the age of the tasters makes no significant difference to the degree of acceptability for all the products tested. These results are similar to those of Salih and Jilal on the consumer test of a cake and biscuit formulation enriched with carob pulp [26].

3.3 Sensory profiles of the pastes and biscuits of the four sesame varieties

Figure 4 shows the results of the sensory profiles of the paste samples of the four sesame varieties.

It can be seen that wollega paste was the most liked and pakresaaya paste the least liked in terms of colour, aroma, taste, texture, viscosity and stickiness. The wollega paste was described by 79.4%, 64.7%, 76.5%, 52.9%, 52.9%, and 47% of tasters respectively as having good colour, good aroma, pleasant taste, very fine texture, fairly concentrated viscosity and moderately sticky appearance. The pakrésaaya paste was described as having a fairly good colour, poor aroma, unpleasant taste, granular texture, not sticky and concentrated viscosity by 47.1%, 58.8%, 61.8%, 64.7%, 88.2%, and 70.6% of tasters respectively.

In terms of smoothness, the S42 paste was described as oily by 64% of tasters, the wollega and humera pastes were described as fairly oily by 64.7% of tasters and the pakrésaaya paste was described as not oily by 61.8% of tasters.

The results of the evaluation of the scores for the descriptors of the pastes of the four sesame varieties are presented in Table 3. The results of the statistical analysis showed that there was a significant difference ($p \leqslant 0.05$) between all the paste descriptors (see Table 3). However, comparison between pairs of samples showed that there was no difference between wollega, S42 and humera pastes in terms of colour, aroma, taste, texture, viscosity and stickiness. All seven of these descriptors are very important for the sensory evaluation of biscuit pastes.

Figure 5 shows the results of the sensory profiles of the biscuit samples of the four sesame varieties.

Concerning the biscuits, those of the wollega varieties were also the most appreciated and those of the pakrésaaya varieties the least appreciated in terms of colour, aroma, taste, texture, hardness, tenderness and appearance (Figure 2). The wollega biscuit was described as having a good colour, good aroma, pleasant taste, crunchy texture, crumbly hardness, fair tenderness and uniform appearance by 72%, 82.8%, 72.4%, 79.3%, 65.5%, 37.9% and 75% of tasters respectively. The pakrésaaya biscuit was described by 55.2%, 41.4%, 48.3%, 58.6%, 41.4%, 65.59% and 62.1% of tasters respectively as having a poor colour, a poor aroma, an unpleasant taste, a fairly crusty texture, a hardness that was neither hard nor friable, a fairly crusty tenderness and a uniform appearance.

The results of the evaluation of the descriptor scores of the biscuits of the four sesame varieties are presented in table 4. The results of the statistical analysis indicated that there was a significant difference ($p \leqslant 0.05$) only between the colour, aroma, aftertaste and texture of the biscuits (see Table 4). This illustrates the importance of these four descriptors in describing the sensory profile of biscuits. These results corroborate those of Goubgou and teams on the description of the sensory profiles of biscuits enriched with different types of oils (refined palm oil, refined cottonseed oil and crude palm oil [25]. However, the comparison between the sample pairs shows that the hedonic evaluation scores for the colour and texture of the Wollega and Humera biscuits are not significantly different. Wollega and Humera paste doughs have the same sensory characteristics.

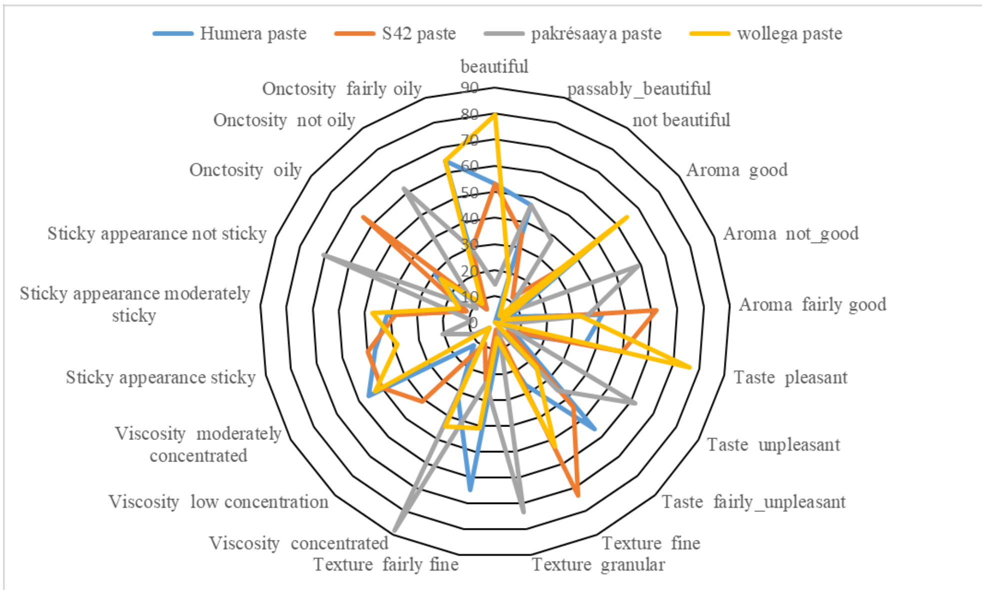

Figure 4. Sensory profiles of paste samples from the four sesame varieties.

Table 3. Results of sensory acceptability tests on paste products

Paste	Colour	Aroma	Taste	Texture	Viscosity	Sticky appearance	Unctuosity	Global acceptability
Wollega	2.76±0.50^{a}	2.62±0.55^{a}	2.76±0.43^{a}	2.47±0.61^{ab}	2.41±0.56^{b}	2.23±0.70^{a}	2.18±0.58^{b}	3.71±1.14^{a}
S42	2.41±0.70^{a}	2.32±0.53^{a}	2.44±0.61^{ab}	2.71±0.52^{a}	1.68±0.64^{c}	2.38±0.70^{a}	2.59±0.61^{a}	3.38±1.07^{a}
Humera	2.53±0.51^{a}	2.47±0.61^{a}	2.26±0.62^{b}	2.18±0.58^{b}	2.21±0.64^{b}	2.32±0.68^{a}	2.23±0.55^{ab}	3.26±0.86^{a}
Pakrésaaya	1.76±0.70b	1.47±0.61^{b}	1.41±0.56^{c}	1.29±0.52^{c}	2.85±0.44^{a}	1.50±0.83^{b}	1.47±0.66^{c}	2.23±0.99^{b}
Pr > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Significant	yes	yes	yes	yes	yes	yes	Yes	yes

Values with the same letter (a, b or c as exponent) in the same column are not significantly different at p<0.05.

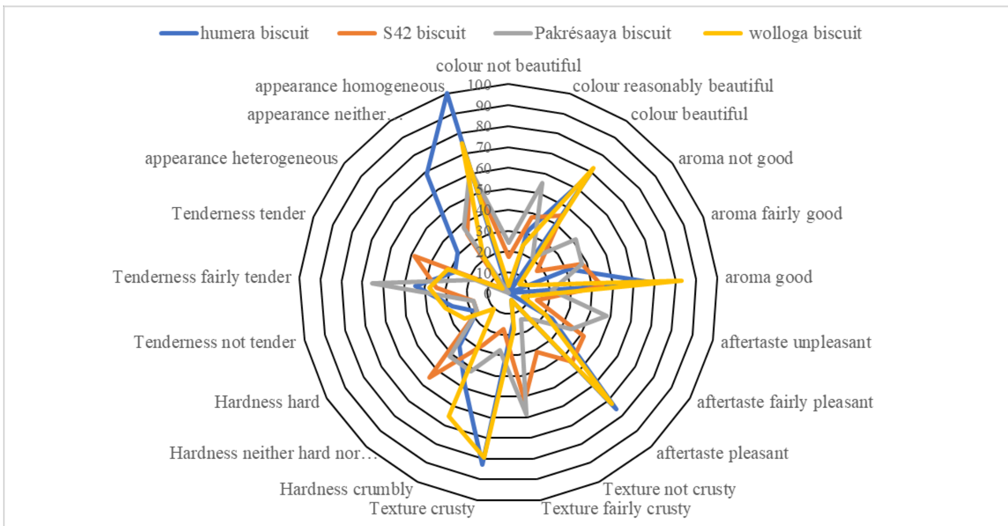

Figure 5. Sensory profiles of biscuit samples of the four sesame varieties.

Table 4. Results of sensory acceptability tests on the biscuits produced

Biscuits	Colour	Aroma	Aftertaste	Texture	Hardness	Tenderness	Appearance	Global acceptability
Humera	2.69±0.47[a]	2.69±0.47[ab]	2.76±0.44[a]	2.79±0.49[a]	1.69±0.76[a]	2.00±0.76[a]	2.69±0.47[a]	4.48±0.63[a]
Wollega	2.69±0.54[a]	2.76±0.58[a]	2.65±0.61[ab]	2.76±0.51[a]	1.59±0.87[a]	2.00±0.80[a]	2.72±0.53[a]	4.21±0.82[a]
S42	2.28±0.75[ab]	2.28±0.75[b]	2.31±0.71[b]	1.86±0.69[b]	1.90±0.67[a]	2.31±0.76[a]	2.59±0.57[a]	3.34±0.90[b]
Pakrésaaya	1.97±0.68[b]	1.79±0.77[c]	1.69±0.76[c]	2.14±0.64[b]	1.76±0.74[a]	2.00±0.60[a]	2.62±0.49[a]	2.76±0.99[c]
Pr > F	0.000	0.000	0.000	0.000	0.473	0.278	0.731	0.000
Significant	yes	no	yes	yes	no	no	No	yes

Note. Values with the same letter (a, b, or c as exponent) in the same column are not significantly different at $p<0.05$.

3.4 Correlations between product sensory descriptors

Tables 5 and 6 show the correlations between the descriptors for paste and biscuits respectively.

Table 5. Correlations between the sensory descriptors of paste: correlation matrix (Pearson)

Variable pate	Colour	Aroma	Taste	Texture	Viscosity	Sticky appearance	Onctuosity	Global acceptability
Colour	**1**							
Aroma	**0.532**	**1**						
Taste	**0.532**	**0.660**	**1**					
Texture	**0.460**	**0.451**	**0.503**	**1**				
Viscosity	**-0.227**	**-0.253**	**-0.288**	**-0.410**	**1**			
Sticky appearance	**0.241**	**0.300**	0.119	**0.341**	-0.121	**1**		
Onctuosity	0.161	**0.303**	**0.378**	**0.432**	**-0.371**	**0.246**	**1**	
Global acceptability	**0.224**	**0.350**	**0.375**	**0.298**	**-0.224**	**0.198**	**0.184**	**1**

Note. Values in bold are different from 0 at the significance level alpha=0.05.

Table 5 shows that there are correlations between the different hedonic descriptors of the paste produced. There was a positive correlation (r = 0.224 to 0.660) between certain hedonic descriptors such as colour, aroma, taste, texture, stickiness, creaminess and overall acceptability (table). Colour was significantly correlated with five other descriptors (aroma, taste, texture, stickiness, and overall acceptability). The aroma was highly correlated with five other descriptors (taste, texture, stickiness, creaminess, and overall acceptability). Next, the taste is associated with three descriptors (texture, unctuosity, and global acceptability). The texture is then correlated with three descriptors (stickiness, unctuosity, and overall acceptability) and finally stickiness with two descriptors (unctuosity and overall acceptability). However, viscosity was negatively correlated with all the other hedonic descriptors (-0.224 to -0.410), which could indicate the importance of colour, aroma, taste, texture, and stickiness in assessing the overall acceptability of the samples.

Table 6 shows the correlations between the different hedonic descriptors of the biscuits produced. There is a positive correlation (r = 0.202 to 0.659) between the sensory descriptors.

Table 6. Correlations between biscuit sensory descriptors: correlation matrix (Pearson)

Variable Biscuits	Colour	Aroma	Aftertaste	Texture	Hardness	Tenderness	Appearance	Global acceptability
Colour	**1**							
Aroma	**0.576**	**1**						
Aftertaste	**0.557**	**0.659**	**1**					
Texture	**0.516**	**0.456**	**0.422**	**1**				
Hardness	**-0.207**	-0.079	-0.076	-0.080	**1**			
Tenderness	0.092	0.166	**0.215**	0.025	0.146	**1**		
Appearance	**0.302**	**0.319**	**0.427**	**0.204**	-0.060	**0.279**	**1**	
Global acceptability	**0.202**	**0.312**	**0.342**	**0.234**	-0.099	-0.101	-0.017	**1**

Note. Values in bold are different from 0 at significance level alpha=0.05.

Colour is significantly correlated with five other descriptors (aroma, aftertaste, texture, appearance, and overall acceptability). Aroma is strongly correlated with four other descriptors (aftertaste, texture, appearance, and overall acceptability). The aftertaste is correlated with four descriptors (texture, tenderness, appearance, and overall acceptability). Texture is correlated with two descriptors (appearance and overall acceptability) and tenderness is correlated with the homogeneous appearance of the biscuits. However, hardness was negatively correlated with colour (-0.207). This could also show the importance of colour, flavour, aftertaste, and texture in assessing the overall acceptability of biscuits. These results corroborate those of other studies which reported that the overall acceptability of biscuits was significantly influenced by other sensory parameters such as colour, aroma, texture, and aftertaste [25, 27].

3.5 Hedonic results for paste and sesame biscuits

Figure 6 shows the results of the hedonic test on paste samples of the 4 sesame varieties. The results show that the majority of tasters (60.6%, 66.7%, and 87.9%) found the humera, S42, and wollega pastes to be pleasant and that 48.5% of tasters found the pakrésaaya paste to be unpleasant. Statistical tests showed a significant difference between the hedonic appreciation of the samples. Comparing the pairs of samples, it was found that the hedonic scores were not significantly different between the humera, S42, and Wollega pastes (Table 3). These three pastes have the same physicochemical characteristics.

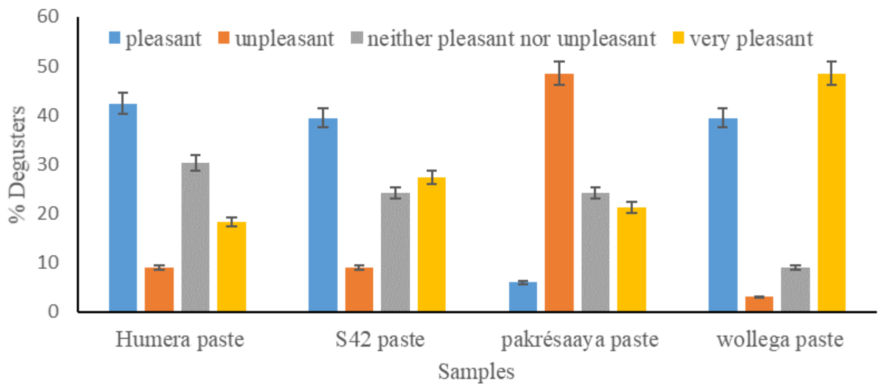

Figure 6. Hedonic test results for paste samples of the 4 sesame varieties.

The results of the hedonic test of the sesame biscuit samples are shown in Figure 7. The majority of tasters, 90%, found the humera and wollega biscuits pleasant, and 50% of tasters found the S42 biscuits pleasant. However, 40% of tasters found the Pakrésaaya biscuit unpleasant. The ratings for the Wollega and humera biscuits were significantly higher than those for the S42 and Pakrésaaya biscuits. The scores for the Pakrésaaya biscuits were the lowest (Table 4).

The results of the biscuit hedonic tests are in line with those of the paste hedonic tests. The acceptability of the paste influences that of the biscuits.

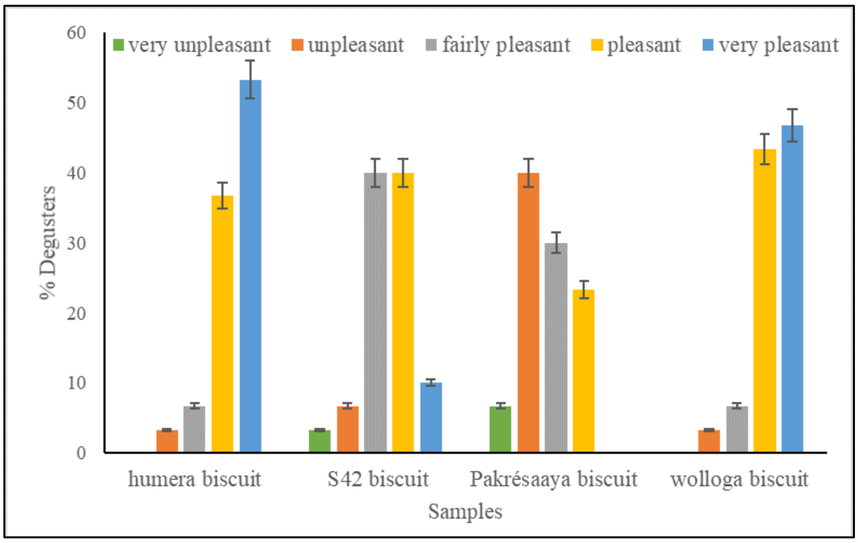

Figure 7. Hedonic test results for biscuit samples of the 4 sesame varieties.

3.6 Ranking results for paste and sesame biscuits

Figures 8 and 9 respectively show the overall rankings of the pastes and biscuits of the 4 sesames varieties by the tasters.

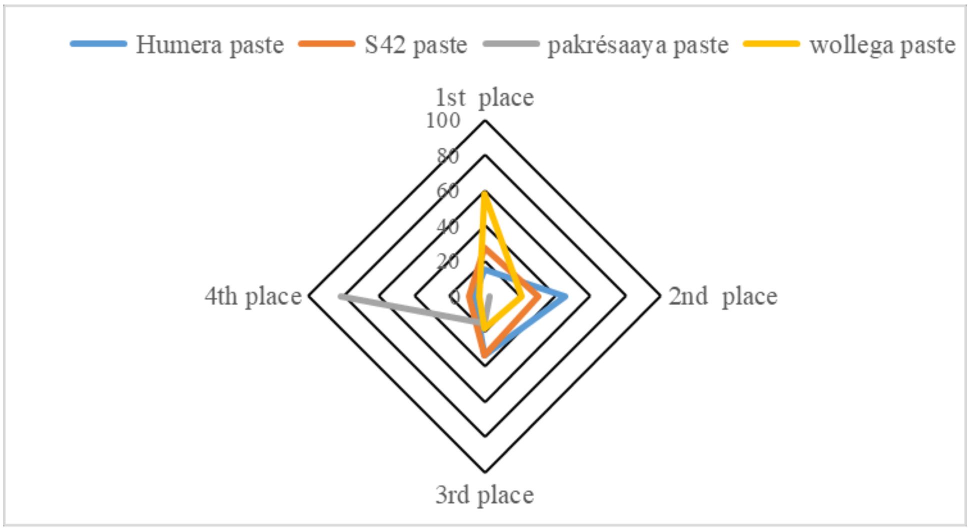

Figure 8. Tasters' general ranking of the pastes of the 4 sesame varieties.

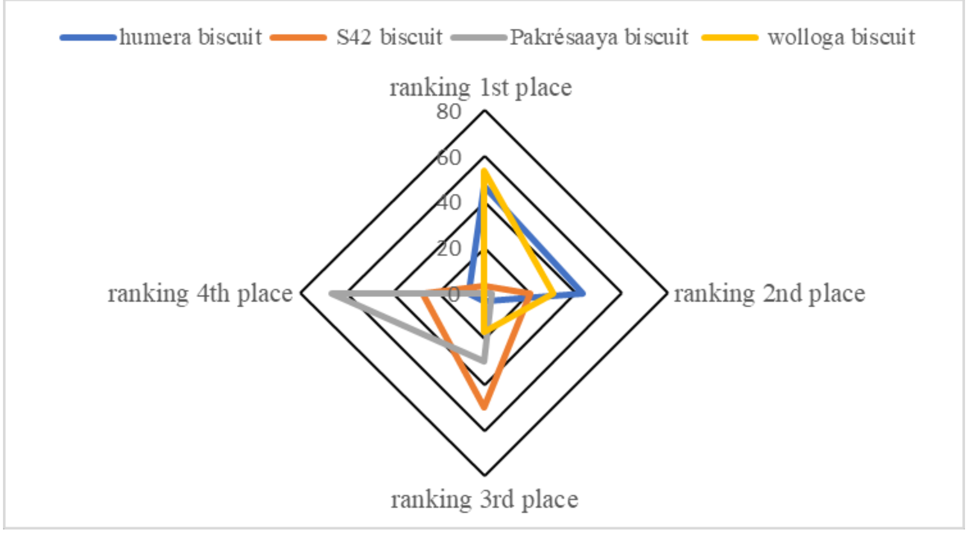

Figure 9. General ranking of biscuits of the 4 sesame varieties by tasters.

The results of the ranking test show that wollega paste comes first with 57.6% of tasters, followed by Humera paste with 45.5% of tasters, then S42 paste with 33.3% of tasters and finally pakresaaa paste with 81.8% of tasters.

For biscuits, the classification results also show that the wollega biscuit comes in first place with 53.3% of tasters, followed by the Humera biscuit with 43.3% of tasters, then the S42 biscuit with 50% of tasters and finally the pakrésaaya dough with 66.7% of tasters. The results of the biscuit classification tests are in line with those of the hedonic test.

4. Conclusion

This study showed that the physicochemical characteristics such as moisture and fatty acidity of pastes and biscuits of the four sesame varieties were significantly different. Sensory analysis showed that the acceptability of the paste of sesame varieties influences that of the biscuits.

The study made it possible to identify the wollega and humera varieties as the two best varieties capable of producing very appreciable biscuits on an organoleptic and physicochemical level. Also, the S42 varieties presented acceptable organoleptic and physicochemical characteristics. As for the Pakrésaaya varieties, it was the least appreciated. In view of these results, the sesame varieties Wollega, humera, and S42 can be recommended to producers of sesame biscuits.

Acknowledgements

The authors would like to thank the reviewers for their contribution to ensuring that the manuscript meets the publication standards of this journal, as well as The National Fund for Research and Innovation for Development (FONRID) for its financial support. The researchers at the Institute for the Environment and Agricultural Research for providing sesame varieties.

References

[1] Oboulbiga EB, Douamba Z, Compaoré-Sérémé D, Semporé JN, Dabo R, Semde Z, Tapsoba FW-B, Hama-Ba F, Songré-Ouattara LT, Parkouda C, & Dicko MH (2023). Physicochemical, potential nutritional, antioxidant and health properties of sesame seed oil: a review. Front. Nutr., 10:1127926. doi: 10.3389/fnut.2023.1127926.

[2] Aslam, M., Shabbir, M. A., Pasha, I., Shukat, R., Siddique, U., Manzoor, M. F. et Ayub, S. (2020). Protective effect of sesame seed oil (sesamum indicum) against hypercholesterolaemia in male sprague-dawley rats. Food Science and Technology, 1, 741-745.

[3] Arab, R., Casal, S., Pinho, T., Cruz, R., Freidja, M. L., Lorenzo, J. M., ... & Boulekbache-Makhlouf, L. (2022). Effects of seed roasting temperature on sesame oil fatty acid composition, lignan, sterol and tocopherol contents, oxidative stability and antioxidant potential for food applications. Molécules, 27(14), 4508.

[4] Andriamarosoa, M. R. F. (2001). Contribution to improving sesame production as a means of combating malnutrition and as an alternative to tavy in the eastern part of the region. Case study of experiments conducted at the CDIA Marolafa Université d'Antananarivo.

[5] Abou-Gharbia, H. A., Shehata, A. A. Y., & Shahidi, F. (2000). Effect of processing on oxidative stability and lipid classes of sesame oil. Food Research International, 33(5), 331-340.

[6] Lafaurie L. (2020). "Sésame: health benefits, nutritional information. Journal des femmes". [Online]. Available: https://sante.journaldesfemmes.fr/fiches-nutrition/2652749-sesame-bienfaits-pour-la-sante-infos-nutritionnelles-calories/#SnippetTab. [Accessed 20 06 2024].

[7] FAOSTAT. (2022). " http://wwwfaoorg/faostat/en/#data/QC," 7 11 2022. [Online]. [Accessed 20 06 2024].

[8] Traoré, T., & Son, B. (2009). Sesame sector strategic plan. Ministry of Agriculture, Water and Fisheries Resources, Ouagadougou.

[9] RONGEAD. (2013). Sesame in Burkina Faso state of lieux 2013.

[10] Agu, H. O., & Okoli, N. A. (2014). Physico-chemical, sensory, and microbiological assessments of wheat-based biscuit improved with beniseed and unripe plantain. Food Science & Nutrition, 2(5), 464-469.

[11] Visavadiya, N. P., & Narasimhacharya, A. V. R. L. (2008). Sesame as a hypocholesteraemic and antioxidant dietary component. Food and Chemical Toxicology, 46(6), 1889-1895.

[12] Aondona, M. M., Ikya, J. K., Ukeyima, M. T., Gborigo, T. W. J., Aluko, R. E., & Girgih, A. T. (2021). In vitro antioxidant and antihypertensive properties of sesame seed enzymatic protein hydrolysate and ultrafiltration peptide fractions. Journal of Food Biochemistry, 45(1), e13587.

[13] MAAH. (2018). "Illustrated manual for the production of certified sesame seeds." Ministry of Agriculture and Water Development, Ouagadougou.

[14] Songré-Ouattara, L. T., Goubgou, M., & Savadogo, A. (2017). Impact of packaging and shelf life on nutritional and microbiological quality of sorghum biscuits enriched with moringa and spirulina. Journal of Applied Biosciences, 109, 10561-10570.

[15] AOAC. (1990). Official Methods of Analysis of the Association of Official Analytical Chemists, Vol. II, 15th ed. Sec.985.29. The Association: Arlington, VA.A.

[16] Association Française de Normalisation (AFNOR). (2000). Determination of moisture content, practical method. Cereals, Pulses, Derived Products, NF V 03-707.

[17] International Standardization Organization (ISO). (1998). Determination of fat content by the Soxhlet extraction method. ISO 659,

[18] ISO. (1998)." Determination of fat acidity of grain milling products." N. F. 7305 ISO Standard, vol. 90, no. 2, p. 7.

[19] NBF. (2006). Norme 01-008, homologated standards for sesame.

[20] Codex Alimentarius. (2017). Guidelines on formulated complementary foods for older infants and young children CAC/GL 8-1991. Amended in 2017. Revised in 2013., FAO, WHO.

[21] Zydembos, S. E., and Humphrey-Taylor, V. (2004). Cookies, biscuits and crackers: The diversity of products. The diversity of products. Pages in Encyclopaedia of Grain Science., Vol. 1.

[22] Songré-Ouattara, L. T., Gorga, K., Savadogo, A., Bationo, F., & Diawara, B. (2016). Assessment of the nutritional suitability of foods used in the complementary feeding of young children in Burkina Faso. Journal of the West African Chemistry Society, 41, 41-50.

[23] Hama-Ba, F., Ouattara, F., Savadogo, A., Simpore, M., & Diawara, B. (2018). Study of the nutritional quality and acceptability of millet biscuits (Pennissetum glaucum L.) supplemented with cowpea (Vigna unguiculata L.) and Bambara groundnut (Vigna subterranea L.). Journal of Agricultural Science and Food Research, 9(1), 1-4.

[24] USAD, Lutheran World Relief et RONGEAD. (1998). Study on norms and standards in the sesame sector. Final report Burkina Faso sesame project. Final version | 03.05.18.

[25] Goubgou, M., Songré-Ouattara L T, Bationo F., Banhoro O., Traoré Y., & vadogo A. (2021). Effect of three types of oils and their level of incorporation on sensory quality of sorghum cookies. Food Research, 5 (3): 190-02.

[26] Salih, G., & Jilal, A. (2020). Food use of carob pulp: formulation and consumer test. Revue Marocaine des Sciences Agronomiques et Vétérinaires, 8(2) : 249-252

[27] Zucco, F., Borsuk, Y., & ntfield, S. D. (2011). Physical and nutritional evaluation of wheat cookies supplemented with pulse flours of different particle sizes. LWT - Food Science and Technology, 44(10): 2070-2076.