

Original Research

Physico-chemical Evaluation and Overall Acceptability of Bread Produced from Five Different Types of Wheat Flour Varieties

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ABSTRACT: The proximate compositions of bread produced from five different types of wheat flour were estimated using compositional analysis of Association of Official Analytical Chemists, while the grains length, width and thickness were determined using Buhler lens measurement equipment. Mixolab was determined using mixolab device. Analysis of variance shows that there was significant difference ($p < 0.05$) in the proximate compositions (moisture, protein, crude fat, crude fibre, ash and carbohydrate) of the wheat varieties studied Gerardo, Altar, Ranco, Plata and Guayacan. Significant difference ($p > 0.05$) exists in the physical properties of the different types of wheat varieties. 1000 kernel weigh, bulk density, length, width and thickness of the grains. Mixolab indices of the flour (water absorption capacity 8.50 to 9.00%, mixing 2.50 to 3.00mins, gluten ranged from 7.50 to 8.00%) showed a significant different at $p > 0.05$. Gerardo, Altar, Ranco, Plata and Guayacan had significantly higher gluten and their ranged of chemical composition were within the specific range. The mixolab indices showed that the wheat grains (Guayacan and Ranco) had good water absorption and high gluten quality, are good for the production of bread.

Keywords: Acceptability, bread, wheat flour, proximate compositions

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INTRODUCTION

Wheat, like most grains, thrives in cool climates and tends to do poorly in warm, humid climates, which often ruins the crop through disease. Although wheat prefers cool climates, they do not grow as far north as heavier grains, such as rye and oat (Kiple and Kriemhild, 2000). The growing period of wheat lasts approximately 90 days and requires little attention other than a period of dry, sunny weather (Katz, 2003). On the other hand, both the quality and the content of the wheat protein are affected by the climatic conditions during wheat Maturation (Abboud and Charles, 2012). Wheat is a principal cereal used for bread making, because of its wheat-baking

properties, as well as its valuable chemical constitution. Nowadays, the quality of raw material is the most important problem for bakers. However, dough from different types of wheat has higher extensibility, and more easily stretched into long pieces without breaking, making them ideal to use in pasta. In contrast, dough made from bread wheat has higher elasticity, which helps them bounce back during kneading, making it a better choice when making bread. They require flour, which has the ability to produce bread with large loaf volume and good crumb texture, with good maintenance properties. Research on determining relationships between the flour

properties and the characteristics of the final product remain a challenge for scientists. Bread properties are very often influenced by flour components (Dowell *et al.*, 2008; Edwards *et al.*, 2007; Perez-Borla *et al.*, 2004) and the rheological properties of the dough. Attempts have been made by other researchers to improve the cultivation of wheat crops grown locally in Nigeria. Mixolab mixes the dough at different temperatures, allowing the study of the dough mixing properties, weakening, gelatinization, gel stability and retro gradation in one test. The objectives of this study were to determine the proximate composition, physical properties, and rheological properties of wheat and to assess the relative yield performance, stability and quality of the wheat genotypes, with the bid to recommending the best for bread production.

MATERIALS AND METHODS

Five improved wheat varieties (Gerardo, Altar, Guayacan, Ranco and Plata), were cleaned, sorted, conditioned and milled into flour using laboratory milling machine. The proximate composition of the grains moisture, protein, crude fat, crude fibre, ash and starch content were adopted by (AOAC, 2000) standard method of analysis. Bulk density determination as described by Onwuka (2005). The grains length, width and thickness were determined using Buhler lens measurement equipment. Mixolab was determined using mixolab device. Sensory evaluation was conducted using 9 point hedonic scale as described by Ihekoronye and Ngoddy (1985). All determinations were carried out in replicated measurement except for sensory evaluation and data collected were analyzed using Minitab statistical software version 17 for windows.

RESULTS AND DISCUSSION

Physical properties of five (5) different types of wheat flour varieties

The 1000 kernel weight ranged from 37.00 to 39.20g, bulk density 0.80 to 0.82g/ml, length 6.10 to 6.90, width 3.23 to 3.83 and thickness 2.69 to 2.80mm. Water absorption capacity ranged from 8.50 to 9.00% (Table 1). There was significant difference ($p>0.05$) in the mean water absorption capacity. The maximum 1000 grain weight (39.20g) was recorded from the *Altar* variety, while the *Guayacan* wheat varieties and *Plata* were not statistically different ($p>0.05$) by showing 39.00 and 38.80 grams of grain weight (Table 1), but further deviate from other two varieties (*Ranco* and *Gerardo* which recorded 37.50 and 37.00 grams respectively) this is similar with finding of Soomoro *et al.*, (2014) who reported a

maximum of 39.4 grams and a minimum of 25.4 for different wheat varieties. 1000 kernel weight measures the mass of the wheat kernel and is an essential parameter for the selection of cultivars with the best physical and physiological seed quality (Néstor *et al.*, 2017). There were no significant difference between *Altar*, *Ranco* and *Plata* varieties which also recorded the highest bulk densities of 0.82g/ml each and does not correlates with *Guayacan* and *Gerardo* which recorded 0.81g/ml and 0.80g/ml respectively. The present finding agreed with what Soliman *et al.*, (2009) who reported an average of bulk densities for 0.89-1.3g/ml, the bulk density of the wheat varieties are important to highlight the correlation with volume of the kernel and air spaces accommodated on the wheat kernel of the cultivar that measured its weight. According to Néstor *et al.* (2017) the density of wheat grains usually varies within a relatively broad range, depending on the species and cultivar, manner of silo, height of deposit, degree of contamination of the grain and other factors. The principal dimensions including the Length (L), Width (W) and Thickness (T) measured in millimeters of the wheat grains are reasonable in selecting sieve separators and for the calculation of extraction rate during size reduction (Al-Mahasneh and Rababah, 2007). *Gerardo* recorded the highest Length value of 6.90mm while differed significantly at $p>0.05$ with other varieties as par recorded as 6.77mm, 6.53mm, 6.40mm and 6.10mm for *Ranco*, *Plata*, *Guayacan* and *Altar* respectively. The result obtained in the present study was in good agreement with research conducted by Soliman *et al.*, (2009) who reported ranges for Sakha-93 wheat variety of 6.60 to 7.20 mm. These measurements can also be used to calculate volume of kernels, which are important during modeling of grain drying, aeration, heating and cooling (Néstor *et al.*, 2017). The measured width of the five varieties shows that *Ranco* recorded the highest value of 3.83mm while the other deduced the mean values of 3.80mm, 3.37mm, 3.33mm and the least 3.23mm for *Plata*, *Guayacan*, *Gerardo* and the lowest *Altar* Variety, the result obtained agreed with findings of Soliman *et al.*, (2009) who reported a ranges for the width of Banusuif-1 variety as 3.41 to 3.66mm. Also the result obtained for the thickness among the five different varieties of wheat described that *Plata* (2.80mm) recorded highest mean value which deviated significantly with other four wheat varieties, the lowest values obtained was observed on sample *Gerardo* with 2.69mm while other varieties also differed significantly including *Guayacan* (2.78mm), *Altar* (2.74mm) and *Ranco* (2.70mm). From the result obtained for the physical properties a clear evidence shows that a variation exist among the five different types of wheat varieties with which sample *Plata* variety described a higher average mean values for the physical properties while the *Gerardo* the least.

Table 1: Physical properties of five (5) different types of wheat flour varieties

Samples	1000 Kernel weigh (g)	Bulk density (g/ml)	Length (mm)	Width (mm)	Thickness (mm)
Gerardo	37.00±0.10 ^d	0.80±1.00 ^c	6.90±0.20 ^a	3.33±0.23 ^e	2.69±3.00 ^e
Altar	39.20±2.00 ^a	0.82±0.10 ^a	6.10±2.00 ^e	3.23±0.20 ^d	2.74±1.01 ^c
Guayacan	39.00±0.00 ^b	0.81±1.01 ^b	6.53±0.02 ^c	3.37±0.30 ^c	2.78±2.00 ^b
Ranco	37.50±0.03 ^c	0.82±1.20 ^a	6.77±1.00 ^b	3.83±2.01 ^a	2.70±0.03 ^d
Plata	38.80±1.00 ^b	0.82±2.01 ^a	6.40±0.00 ^d	3.80±1.01 ^b	2.80±0.00 ^a

Values are mean of three replicates ± Standard Deviation, number in the same column followed by the same letter are not significantly different at $p > 0.05$ level.

Table 2: Proximate composition and Calorie Values of five (5) different types of wheat flour varieties

Samples	Moisture content (%)	Crude protein (%)	Crude fat (%)	Crude fibre (%)	Ash (%)	Carbohydrate (%)	Calorie (kcal/100g)
Gerardo	11.50±0.01 ^b	14.15±1.01 ^b	1.27±1.00 ^c	1.30±0.03 ^c	0.88±0.31 ^a	72.70±0.00 ^a	358.83±1.00 ^c
Altar	10.85±0.00 ^e	14.40±0.10 ^a	1.20±0.00 ^d	1.28±1.00 ^d	0.85±2.00 ^b	72.70±0.30 ^a	359.20±0.01 ^b
Guayacan	11.20±1.10 ^c	14.00±0.01 ^c	1.28±0.00 ^b	1.35±2.01 ^b	0.85±1.01 ^b	72.55±0.02 ^a	357.72±0.00 ^e
Ranco	11.15±0.0 ^d	13.85±2.01 ^e	1.25±1.20 ^e	1.30±1.10 ^c	0.82±0.00 ^c	72.93±0.10 ^a	358.37±0.01 ^d
Plata	11.90±0.00 ^a	13.95±1.10 ^d	1.46±1.12 ^a	1.38±2.03 ^a	0.80±0.00 ^d	72.89±0.01 ^a	360.50±0.00 ^a

Values are mean of three replicates ± Standard Deviation, number in the same column followed by the same letter are not significantly different at $p > 0.05$ level.

Proximate composition% and Calorie Values (Kcal/100g) of five (5) different types of wheat flour varieties

There were variations ($P < 0.05$) of proximate composition, physical properties and mixolab indices of the five different types of wheat grains and flours. The moisture, protein, fat, ash, crude fibre and carbohydrate contents ranged from 10.85 to 11.90, 13.85 to 14.40, 1.20 to 1.46, 0.80 to 0.88, 1.28 to 1.38 and 72.55 to 72.93%, respectively, which is in line with Oberoi *et al.* (2007). The results presented in (Table 2) revealed that the highest moisture content was recorded on *Plata* variety of 11.90% of the different types of wheat varieties while *Altar* variety has the lowest amount of 10.85% while *Guayacan*, *Gerardo* and *Ranco* were observed as 11.50%, 11.20% and 11.15% respectively. Moisture content of the wheat cultivar is an important index that revealed the storage stability of the product and signifies the characteristics of the flour during milling; sample with lowest moisture content is desirable for storage under good condition for to cope up seasonal gluts. The result obtained was in line with finding of Ayed *et al.* (2022) who reported ranges of 11% to 14% although higher than of our findings which are possible due to variation of environmental factors and genotype. ISO international organization for standardization (2009) recommended the use of moisture content lower than 14.5% in commercialization of wheat for further processing. However, *Altar* contain the highest content of the crude protein which was recorded as 14.40% come next by *Gerardo* which recorded (14.15%) followed by *Guayacan* (14.00%), *Plata* (13.95%) while the lowest value of crude protein was (13.85%). The result exceeded the value obtained on Bane suif 1 of wheat variety (12.50%) but in good agreement with other reported crude proteins of 13.50-14.30% for different wheat varieties as reported by

Abd El-Sattar and Mostaf (2017). Also he reported that high levels of proteins as well as gluten quantity and strength are the predominant factors associated with superior bread- and pasta-making quality. Also According to Galterio *et al.*, (1993); Mariami *et al.*, (1995); Ayed *et al.*, (2022) wheat with 13% of protein per dry matter can provide excellent products, whereas wheat with protein content below 11% dry matter gives products of inferior quality. Moreover, (Table 2) presented a result of fat content of the five different types of wheat varieties, the highest content was observed on *Plata* wheat variety (1.42%) followed by *Guayacan* (1.28%), *Gerardo* (1.27%), *Ranco* (1.25%) and the least *Altar* with 1.20% this exceeded of some researches as recorded by Abd El-Sattar and Mostaf (2017). The crude fiber obtained in wheat variety help in digestion of food products through the colon, the highest amount was recorded also for sample *Plata* wheat variety of 1.38% and the least amount was recorded also for sample *Altar* of 1.28%, this is essential because of lack for information to elabolarates on the crude fiber content of the mentioned wheat varieties. The ash content of each variety was presented on (Table 2) and the highest amount was recorded on *Gerardo* wheat variety of 0.88% while *Altar* (0.85%) and *Guayacan* (0.85%) does not show a significant difference ($p > 0.05$) but differ significantly with *Ranco* (0.82%) and *Gerardo* (0.80%). The ash content among the different wheat varieties indicated the amount of minerals encapsulated on the kernel that are required for the body system. Also the carbohydrate content of the five different varieties of wheat was recorded in this findings as presented in (Table 2), the result obtained does not show significant difference ($p > 0.05$) among all the samples. The present findings is lower than the mean values of the carbohydrate content of other wheat varieties reported by Abd El-Sattar and Mostaf (2017) who reported a range of 83.26% to 84.96%.

Table 3: Mixolab indices of five (5) different types of wheat flour varieties

Samples	Water absorption capacity (%)	Mixing (mins)	Gluten (%)	Viscosity (Ns/m ²)
Gerardo	8.50±1.01 ^c	2.50±0.10 ^c	8.00±0.00 ^a	7.00±0.01 ^a
Altar	9.00±0.00 ^a	3.00±0.20 ^a	7.50±1.02 ^b	6.40±1.11 ^b
Guayacan	9.00±2.01 ^a	3.00±0.03 ^a	8.00±2.00 ^a	5.80±1.01 ^d
Ranco	8.50±2.00 ^c	2.60±1.22 ^b	8.00±0.00 ^a	6.00±1.01 ^c
Plata	8.80±0.00 ^b	2.60±1.01 ^b	7.50±0.00 ^b	6.00±1.10 ^c

Values are mean of three replicates ± Standard Deviation, number in the same column followed by the same letter are not significantly different at $p > 0.05$ level.

Bread production of five (5) different types of wheat flour varieties

Mixolab was used to measure the rheological properties of a dough for the five different varieties used in the bread making, the result obtained as presented in (Table 3) with water absorption capacity of the dough (8.50-9.00%), mixing time 2.50 to 3.00mins, gluten from 7.50 to 8.00% and viscosity from 5.85 to 7.00Ns/m². The water absorption capacity of the five different varieties shows that the highest content was observed in *Altar* and *Guayacan* with 9.00% each that does not show a significant difference ($p > 0.05$) followed by *Plata* (8.80%) while the lowest amount were recorded on *Ranco* and *Gerardo* with 8.50% each. Water absorption capacity is of particular interest for common wheat that described the dough behaviour during mixing and on the strength of the gluten network. This provided information for the five different varieties of wheat on the dough characteristics by varied water absorption capacity, it was observed that the dough of the flours prepared show a different characteristics that was used to evaluate the rheological behavior and pasting properties which help for adjustment of the dough mixing parameters. The higher WAC of flour could be attributed to the presence of higher amount of carbohydrates (starch) and fibre in the flour. Gluten is one of the most important quality parameter in the wheat grain because of the formation for network during dough making to give the bread a desirable shape. Result obtained in the present study show that there were no significant difference among the *Ranco*, *Guayacan* and *Gerardo* wheat varieties with 8.00% each but which differed with *Altar* and *Plata* with 7.50% each that also does not statistically deviates at $p > 0.05$. Abd El-sattar and Mostaf (2017) reported an average value of gluten content from a lowest of 8.35% to a maximum of 12.50% which is higher than that of our findings; this is possible as a result of the difference types of wheat varieties and environmental growth factor. The viscosity of the dough produced using five different varieties of wheat was evaluated as presented in (Table 3). The result obtained shows a significant difference among the samples with exception of *Plata* and *Ranco* that does not described a statistical difference at $p > 0.05$. Viscosity is an important

parameter that described characteristic flow of the dough through press that is it described the resistance of the dough to liquid flow and from the result obtained *Gerardo* has the highest amount of 7.0 Ns/m² followed by *Altar* (6.40Ns/m²) and lowest *Guayacan* (5.80Ns/m²). Moreover, the mixing time of the flour during bread making was evaluated as presented in (Table 3). There was a significant difference among the samples with *Altar* and *Guayacan* taking longer mixing time than other wheat flour of 3.00 min each while differed with other flours for the three different wheat varieties. Mixing time is essential parameter that denotes the time taken to mix the flour and other ingredients for the dough making that illustrates final characteristics of the bread products.

Bread production process of five (5) different types of wheat flour varieties

Table 4 shows the result of bread production process of five (5) different types of wheat flour varieties for its baking properties which includes Gerardo, Alter, Guayacan, Ranco and Plata varieties of wheat bread samples were compared for baking quality. The water absorption capacity of the wheat bread samples from (Gerardo, Alter, Guayacan, Ranco and Plata varieties) were significant at ($P \leq 0.05$) level of significance with a mean value of 210 (ml) in all the samples when compared which implies the production process does not alter the composition of the wheat varieties during processing into flour and its baking properties were not affected (Joel *et al.*, 2013), this applies that the functional properties of different types of wheat flour has the uniform water absorption capacity most have attributed to its uniformity in mixing time, proofing and the baking time respectively (Dewettinck, *et al.*, 2008). The result shows that the mixing time of the different types of wheat varieties were significant in all the varieties with a mean value of 11.00 (min), the proofing time had a mean value of 180.00 (min) as well as the baking time with a mean value of 20.0 (min). The mixing time, proofing time and the baking time of the dough obtained from different types of wheat flour (Gerardo, Alter, Guayacan, Ranco and Plata varieties) were all significant at ($P \leq 0.05$) in all the different types of wheat bread samples which

Table 4: Bread production process of five (5) different types of wheat flour varieties

Samples	WAC (ml)	Mixing time (min)	Dough weigh (g)	Proofing time (Min)	Baking time(Min)	Loaf weight (g)	Loaf volume (cm ³)	Specific volume((cm ³ /g)	loaf
Gerardo	210±0.00 ^a	11±0.00 ^a	624±0.01 ^c	180±0.00 ^a	20±0.00 ^a	276±0.00 ^b	1950±0.20 ^d	7.07±0.11 ^d	
Altar	210±0.00 ^a	11±0.00 ^a	625±0.00 ^b	180±0.00 ^a	20±0.00 ^a	275±0.01 ^c	1850±0.01 ^e	6.73±0.00 ^e	
Guayacan	210±0.00 ^a	11±0.00 ^a	624±0.10 ^c	180±0.00 ^a	20±0.00 ^a	274±0.11 ^d	2000±0.10 ^c	7.30±0.01 ^c	
Ranco	210±0.00 ^a	11±0.00 ^a	626±0.02 ^a	180±0.00 ^a	20±0.00 ^a	276±0.02 ^b	2150±0.10 ^a	7.79±0.20 ^a	
Plata	210±0.00 ^a	11±0.00 ^a	625±0.11 ^b	180±0.00 ^a	20±0.00 ^a	278±0.10 ^a	2100±0.02 ^b	7.55±0.10 ^b	

Values are mean of three replicates ± Standard Deviation, number in the same column followed by the same letter are not significantly different at p> 0.05 level

Table 5: Bread acceptability of five (5) different types of wheat flour varieties

Samples	Appearance	Crust/crumb	Taste	Crumb colour	Texture/mouth feel	Flavour	Overall acceptability
Gerardo	7.0±0.10 ^b	6.5±0.00 ^b	6.0±0.00 ^b	6.5±0.11 ^b	6.0±0.00 ^b	6.5±0.00 ^a	6.5±0.11 ^b
Altar	6.0±0.00 ^c	5.5±0.10 ^c	6.0±0.01 ^b	6.5±0.10 ^b	6.5±0.10 ^a	6.0±0.01 ^b	6.5±0.01 ^b
Guayacan	7.0±0.01 ^b	7.5±0.11 ^a	6.0±0.00 ^b	7.0±0.01 ^a	6.0±0.20 ^b	6.0±0.10 ^b	7.0±0.00 ^a
Ranco	7.0±0.11 ^b	6.5±0.10 ^b	6.5±1.00 ^a	7.0±0.00 ^a	6.5±0.11 ^a	6.0±0.00 ^b	7.0±0.00 ^a
Plata	7.5±0.20 ^a	6.5±0.10 ^b	6.5±0.10 ^a	6.0±0.01 ^b	6.0±0.20 ^b	6.5±0.11 ^a	6.0±0.10 ^c

Values are mean of three replicates ± Standard Deviation, number in the same column followed by the same letter are not significantly different at p> 0.05 level.

explained its functional and rheology properties during processing. The characteristics, along with its protein content and gluten strength, make it suitable for raw material during processing (Dewettinck *et al.*, 2008; Onwuka, 2005). The dough weight of the bread samples ranged from 624.0 to 626 (g). The result showed that bread sample from Ranco variety had the highest mean value followed by altar variety to the least mean value in sample Gerar and Guayacan. The high mean value obtained may be attributed due to mixing processing and the level of proofing in individual samples as reported by (Minervini *et al.*, 2012). The gluten network formed to trap air during swelling of the dough also created pores for moisture migration (Joel *et al.*, 2013). The specific volume of the different types of wheat breads (Gerardo, Alter, Guayacan, Ranco and Plata varieties) ranged from 6.73 to 7.79 (cm³/g) while the value for the ranco wheat bread sample was 7.79 (cm³/g) and the highest. The significant difference in loaf volume of the wheat bread samples were affected by the whole grain flour used in the production (Dewettinck *et al.* 2008). Elleuch *et al.* (2011) reported that, the main problem of using whole grain flour in baking is the important reduction of loaf volume due to the dilution of gluten network thereby increasing the loaf weight of the bread. The hydration capacity is an indication of the ability of the sample to absorb moisture especially during storage (Onwuka, 2006). The loaf weight ranged from the least mean value to the highest which ranged from 275 to 278 (g), while the loaf volume ranged from 1850 to 2159 (cm³) in whole wheat bread samples. The significant difference noticed among the samples may be attributed due to the gluten network

formed to trap air during swelling of the dough also created pores for moisture migration which in turns affect the volume as well as the specific volume respectively (Elleuch *et al.* 2011).

Bread acceptability of five (5) different types of wheat flour varieties

The result of sensory attributes of the bread samples produced from different varieties of wheat samples such as; (Gerardo, Alter, Guayacan, Ranco and Plata) samples were presented on (Table 5). The appearance of the bread samples ranged from 6.0 to 7.5, were sample Plata were rated highest, followed by sample Gerardo, Ranco and Guayacan were significantly the same as rated by the panelists to the least mean score value of 6.0 in sample Altar (Elleuch *et al.*, 2011; Jones *et al.*, 2015). The significant difference occurred among the samples implies the individual preference and well as the effect of changes during baking. The crust / crumb ratio of the bread ranged from 5.5 to 7.5, were sample Gerardo, ranco and plat did not differ at (P≥ 0.05) while significantly different form altar and guayacan which mixing and baking process were the crust formation tends to vary depending on the amount of temperature received during baking and the reaction between the ingredient (Molfetta *et al.*, 2021). The taste of the wheat bread samples were must preferred in ranco and plata bread samples as rated by the panelists with a mean value of 6.0 to 6.5 respectively. The guayacan and ranco bread received the highest score at (P ≤0.05) for crust color (Table 5). The lowest score in gerardo, alta and

plata (≤ 0.05) for color was found the acceptability of the bread by the panelists (Molfetta, *et al.*, 2021). The texture / mouth feel of the bread samples were significantly accepted and the flavour of the sample were significantly impacted by the reaction between yeast, salt and the other composition of the product (Joel, *et al.*, 2013). Table 5 summarizes the results for the sensory evaluation and overall acceptability of the whole wheat bread samples.

Conclusion

The wheat grains Gerardo, Altar, Ranco, Plata and Guayacan had significantly higher gluten and their ranged of chemical composition were within the specific range. And from the mixolab indices showed that the wheat grains guayanacan and ranco were overall accepted and good for the production of bread and other local wheat products such as alkaki and *gurasá*.

REFERENCES

- Abboud A. S., Charles S.B. (2012). Bread Wheat Quality: Some Physical, Chemical and Rheological Characteristics of Syrian and English Bread Wheat Samples: *www.mdpi.com/journal/foods*
- Abd El-Sattar, A. S and Mostafa A. M (2017). Physico-Chemical and Technological Properties of some New Hard Wheat Varieties. *J. Food and Dairy Sci., Mansoura Univ.*, **8**(9): 383- 386.
- Al-Mahasneh, M.A and Rababah, T.M.(2007).Effect of Moisture Content on Some Physical Properties of Green Wheat. *Journal of Food Engineering*, **79**:1467–1473.
- AOAC. (2000). *Official Methods of Analysis*, 15th Ed., Vols 1 & 2, Association of Official Analytical Chemists, Washington, Dc.
- Ayed, S., Trad, H., Teixeira da Silva, J. A., Othmani, A., Bouhaouel, I., Helel, R., Slim-Amara, H. (2022). Quality assessment of hard wheat landraces and modern varieties through physico-chemical properties. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, **15**(1): 56-467 DOI: 10.9790/2380-1501025667 *www.iosrjournals.org*
- Dewettinck, K., F. Van-Bockstaele, B. Kühne, D. Van-De Walle, T.M. Courtens and X. Gellynck, (2008). Nutritional value of bread: Influence of processing, food interaction and consumer perception. *J. Cereal Sci.*, **48**: 243-257.
- Dowell F.E., Maghirang E.B., Pierce R.O., Lookhart G.L., Bean S.R., Xie F., Caley M.S., Wilson J.D., Seabourn B.W., Ram M.S., Park S.H., Chung O.K. (2008). Relationship of bread quality to kernel, flour, and dough properties. *Cereal Chemistry* :**85**, 82–91.
- Edwards N.M., Preston K.R., Paulley F.G., Gianibelli M.C., Mc-Caig T.N., Clarke J.M., Ames N.P., Dexter J.E (2007). Hearth bread baking quality of hard wheat varying in protein composition and physical dough properties. *Journal of Science. Food Agriculture*: **87**,2000–2011.
- Elleuch, M., D. Bedigian, O. Roiseux, S. Besbes, C. Blecker and H. Attia, (2011). Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. *Food Chem.*, **124**: 411-421.
- Galterio, G., Grita L., Brunori A. (1993). Pasta making quality in Triticum hard. *New indices from the ratio among protein components separated by SDS-PAGE. Plant Breeding*, **110**: 290–296.
- Gbadamosi S. O., Oladeji, B. S. (2013).Comparative studies of the functional and physico-chemical properties of isolated cassava, cocoyam and breadfruit starches. *International Food Research Journal*.**20**(5): 2273- 2277.
- Ihekoronye, A.I., Ngoddy, P.O. (1985). *Integrated Food Science and Technology for the tropics*. Macmillan Educational Ltd, London. P.258.
- ISO international organization for standardization (2009), cereals and cereal products. Determination of moisture content. Reference method, <http://www.iso.org/standard/4583.html>(last accessed: December 20,2022)
- Joel N., James O. and Simeon A. (2013): Comparative Evaluation of the Nutritional and Sensory Quality of Major Commercial Whole-wheat Breads in Nigerian Market. *Advance Journal of Food Science and Technology* **5**(12): 1600-1605.
- Jones, J.M.; Peña, R.J.; Korczak, R.; Braun, H.J. (2015): Cimmyt series on carbohydrates, wheat, grains, and health: Carbohydrates, grains, and wheat in nutrition and health: An overview. Part I. Role of carbohydrates in health. *Cereal Foods World*, **60**, 224–233.
- Katz, S. H. (2003), *Encyclopedia of Food and Culture*. New York: Charles Scribner.
- Kiple k. F., Kriemhild C. O. (2000). *The Cambridge World History of Food*. New York: Cambridge University Press.
- Mariami, B.M., D'Egidio, M.G and Novaro, P. (1995). Hard wheat quality evaluation: influence of genotype and environment. *Cerealchemistry*.**72**:194-197.
- Molfetta, M.; Celano, G.; Minervini, F. (2021). Functional, Nutritional, and Sensory Quality of Mixed Flours-Based Breads as Compared to Hard Wheat Semolina-Based Breads. *Foods* Vol. **10**, Pp: 1613.
- Néstor, P.G., Benjamín, R.W., Anayansi, E.A., Patricia, T.C and Sergio O.S (2017). Grading Factors of Wheat Kernels Based on Their Physical Properties. *Intech Open Science*. 276-289. Accessed via <http://dx.doi.org/10.5772/67246>.
- Oberoi D.P.S., Sogi D.S, Gill B.S (2007). Noodle Processing Technology. *Bev. Food World* **34**(10):68-70, 72.
- Onwuka, G I (2005) *Food Analysis and Instrumentation Theory and Practice*. Science and Education. An open Access and Academic publisher. *Naphathali prints, Nigeria* 95-96.
- Perez-Borla O.P., Leonor M. E., Saiza A., Fritza R.(2004),. Quality parameters and baking performance of commercial gluten flours. *Food Science and Technology*: Vol. **37**:Pp: 723–729.
- Soliman N. S., Abd El Maksoud, M.A., Gamea, G.R and Qaid,Y.A (2009). Physical characteristics of wheat grains. *Misr J. Ag. Eng.*, **26**(4): 1855- 1877.
- Soomoro, A. F., Nizamani, F. K., Kolachi, A. A., Soomoro, K. B and Solangi, K. A (2014). Evaluation of different hard wheat varieties under stress conditions (Brackish water & coarse textured soil). *International Journal of Current Research and Academic Review*.**2**(7): 11-17.