MedCrave
Step into the World of Research

Journal of Food Processing & Technology

Research Article

Open Access

CrossMark

Effect of inverted sugar syrup and raw sugar on the quality and sensory acceptability of white bread production

Abstract

This study was carried out on the quality and sensory acceptability of white bread (WB) produced using Inverted Sugar Syrup (ISS) and Raw Sugar (RS) as sweetening agents. The results for both ISS sweetened and RS sweetened WB obtained showed Calories (180.88 and 186.30), %Fat (2.244 and 1.863), Saturated Fat (0.9 and 0.414), Cholesterol (0.00 and 0.00), Sodium (463.08 and 414.00), %Carbohydrate (34.408 and 38.226), %Protein (5.168 and 6.624), %Fat (10.9 and 8.8), saturated fat (0.204 and 1.9) %Carbohydrate (72.2 and 77.9) and %Protein (11.4 and 14.2). The Specific volumes of the both samples of WB were 4.90cm^3/g and 4.70cm^3/g, for ISS sweetened and RS sweetened WB, respectively. The sensory evaluation of the product indicated that for Day 1 there was no significant difference in the both samples of WB in terms of their taste (mouth-feel), colour, texture, aroma and overall acceptability, ($P < 0.05$). For Day 2, it indicated that there was significant difference in the WB in terms of their texture but there was no significant difference in the term of their taste, colour and overall acceptability ($P < 0.05$). For Day 3, indicate that there was no significant difference in term of their taste; colour aroma texture and overall acceptability ($P < 0.05$). And For Day 4, it indicated that there was no significant difference in term of their taste, colour aroma texture and overall acceptability.

Keywords: white bread, inverted sugar syrup, raw sugar, sensory, attributes, quality

Volume 13 Issue 2 - 2025

Mohammed SF,[1,2] Shuaibu J,[1] Mohammed AD[1,2]

[1]School of Science and Technology, Department of Food Science and Technology, Federal Polytechnic, Nigeria

[2]School of Science and Technology, Department of Nutrition and Dietetics, Federal Polytechnic, Nigeria

Correspondence: Mr Mohammed SF, School of Science and Technology, Department of Food Science and Technology, Federal Polytechnic, PMB 1012, Kaura Namoda, Zamfara State, Nigeria, West Africa Tel +234 7030072425

Received: August 11, 2025 | **Published:** November 18, 2025

Introduction to the study

The quest to use Inverted Sugar Syrup (ISS) for the production of White Bread (WB) prompted this research.WB is typically refers to breads prepared from bleached wheat flour that is light in colour from which the bran and the germ layers have been removed (and set aside) from the Wheat berry as part of the flour grinding or milling process.[1] This milling process can give wheat flour a longer shelf-life by removing the natural oils from the whole grain. Removing the oils allows products made with the flour white bread to be stored for longer period of time avoiding potential rancidity.[1] The flour used in making WB may be bleached that is lightened further by the use of chemical such as Potassium bromate, Azodicarbonmide or Chlorine dioxide gas to remove any slight, natural yellow shade and make its baking properties more predictable.[1]

Bread is a universally accepted as a convenient form of food that demonstrated a characteristic acceptability to all population rich and poor, rural and urban.[2] The consumption of bread among Nigeria has gained tremendous popularity; but the cost of its production in terms of raw sugar usage and its shelf life are important factors for its pricing and acceptability by the consumers.[3,4] Also, the use of raw sugar in the production of bread could lead to the development of fungal and bacteria including *Bacillus subtilis*, *Bacillus licheniformis, Mucor* sp. *Aspergillus* sp. and *Rhizopus* species.[5] Perhaps the use of ISS for bread production could be a means of reducing cost of production in the bakery industries and control the spontaneous growth of microbes that could lead to its unstable shelf life. And it has been discovered that Yeast spores are ubiquitous (i.e. found everywhere) including the surface of cereal grains; so any dough left to rest will become naturally leavened;[5] there were multiple sources of leavening available for early bread production; airborne Yeast could be harnessed by leaning uncooked dough exposed to air for sometimes before cooking; parts of the ancient world that drank Wine used paste composed of Grape juice and flour that was allowed to begin fermentation; or wheat bran steeped in Wine as a source for Yeast.[6] In addition, the most common sources of leavening was to retain a piece of dough from the previous day to use as a form of sour dough starter; a major advance occurred in 1961 with the development of the Chorleywood bread process (CBP), which used the intense mechanical working of dough to dramatically reduce the fermentation period and the time taking to produce a loaf of bread.[6] The CBP, whose high-energy mixing allows for the use of lower protein grains, is now widely used around the world in large bakeries; as a result, bread can be produced rapidly and at low cost from the Bakers to the consumer.[6] In this study, white (i.e. bleached) Wheat flour would be used in the production of WB. Hence, the functions of Wheat flour, Yeast, Sugar, Salt and potable water in the production of white bread (WB) are well explained by several researchers.

However, in this study ingredients used in the production of WB include all listed ingredients above. Wheat flour is essential to the structure of dough, the flour protein (Gluten) forms the skeleton of the dough structure and gluten consists of Gliadin and Glutenin; contribute viscosity to gluten.[7] When the Gliadin and the Glutenin, hydrated together, they form a three dimensional gluten network. Shortening such as fat or butter has been used because this contributes to the improving the loaf volume. Shortening has a lubricating action on the gluten matrix possibly by lowering the resistance of the dough to diffusion and expansion of leavening of gas that would increase the volume and improves the dough. Water plays an important role in bread quality as it hydrates gluten protein during mixing.[7] In bread production, salt is a very important ingredients, as it improves the taste, the flour of bread, it stabilizes the fermentation process and it gives the strength to the gluten; it controls the action of yeast and thus controls volume of loaf. It improves flavor and facilitates the action of aiding in dough. Salt also prevent the action of flour *proteases*, which

depolymerize protein of the gluten complex.[8] Another important ingredient that affects the bread quality is the Yeast; its fermentation process contributes to flavor and the rheological properties of dough and produces gas for leavening function.[2,9,10] Sugars are usually used by Yeast during the early stage of dough fermentation [11]; and later by action of enzymes in the flour, main sugars are released for CO_2 production, in order to increase CO_2 production to improve the crust colour and the sweetened the bread, extra sugar can be added.[11] Retarding and pasting a native starch function as anti-staling ingredient which prevents starch re-crystallization, sugar also acts as an anti-plasticizer.[11] Also, potable water is essential for the fermentation of dough. It is responsible for the folding of dough; it facilitates the dispersion of Yeast cell and it is necessary for the dissolution of salt and sugar. Potable water is important for the activation of flavor enzymes, which leads to the development of new bonds between the macro molecules in the flavor and changes the rheological properties of dough.[12] There are basically three (3) types of bread namely; White, brown and whole meal, respectively.[1,13] Bread is available in whole range of shapes and sizes, crusty or soft crusted, wrapped or unwrapped, sliced or unsliced. And bread shall be considered as having a good volume if its volume/weigh ratio is not less than 4.00 cm^3/g.[10] The shelf-life of preserved baked product such as the white bread stored in a conventional condition (within natural atmosphere at room temperature) is as short as three (3) to four (4) days. Freshness lose may be attributed to several factor with microbial spoilage resulting from increase water activity and oxygen content being the most common one.[14] In addition, fungi *(Mucor species, Aspergillus species and Rhizopus species)* are known to spoil bread, leading to huge economic loses and as well compromising the safety of bread.[14,15]

However this study seeks to establish the use of ISS (Figure 1) as an alternative agent of sweetening WB.[16] This study could be an eye opener for the bakery operators to adopt the use of ISS to sweeten WB for the purpose of monitoring their respective sensory attributes and establishing their expected quality attributes, so that sustainable development goals of our dear nation can be ensured and achieved. In a nutshell, this research is aimed at producing WB using the straight dough method (SDM).[17] The SDM is a common method practice in Nigeria baking industry.[17]

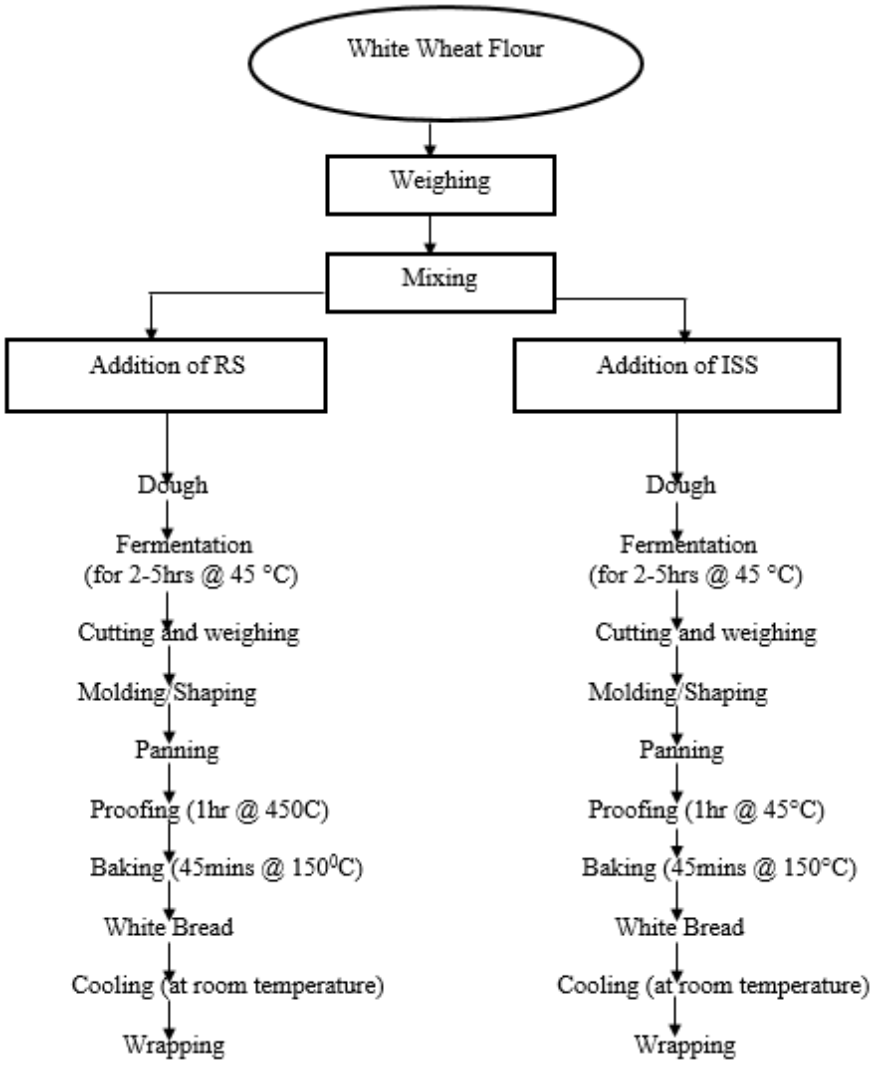

Figure 1 Process flow diagram for the production of WB using ISS and Raw Sugar.

Sources: Modified methods of [3,7,19,20]

Citation: Mohammed SF, Shuaibu J, Mohammed AD. Effect of inverted sugar syrup and raw sugar on the quality and sensory acceptability of white bread production. *MOJ Food Process Technol.* 2025;13(1):88–92. DOI: 10.15406/mojfpt.2025.13.00328

Materials and methods

Materials used for the production of WB included wheat flour, Raw Sugar (RS), Inverted Sugar Syrup (ISS), Yeast, salt, Dough-risen Tablet, and potable water, respectively. And the equipment and utensils used in this research included Electronic weighing balance (Model KD-BV, China), Stainless bowl, Dough Mixer (Model DM-China), Hot Air Oven (Model GZX-GF-400) and Nutritional Electronics Scale (Model VC-10104-E, Coventry, UK).

Sources of the raw materials

All the raw materials and ingredients used for this study were bought from the Shehu Bala Giwa Provision Store, Kaura Namoda, Zamfara state. The potable water and other equipment were sourced from the Food Processing Workshop, department of Food Science and Technology, Federal Polytechnic, Kaura Namoda, Zamfara state, Nigeria.

Methodology for production of wb using iss and rs as sweeteners

Method of Mohammed SF, [16] was adopted for the production of ISS while modified Method (Figure 1) of Badifu GI, [17] was adopted and employed in the production of both samples of WB sweetened with ISS and RS.

Experimental design for the production of white bread (WB)

ISS and RS were used in the production of WB samples; the preparation of samples of WB was done under a hygienic condition using the modified method of.[17] The two samples were used as the basis for comparison. Nutritional profiling on the both samples was conducted using Nutritional Electronic Scales (Model VC-10104E, Coventry, UK). And 9-Point Hedonic Scale Questionnaire was designed and administered to 10 sensory Judges for sensory evaluation on the two samples; and sample 215 serving as the Control.[18] And specific volume of the both samples was determined using the method of Shuaibu.[4] All data were recorded in duplicates and results were presented in Tables.

Ingredients formulation for the production of wb using iss and raw sugar

The ingredients (Table 1) for the production of WB using ISS and RS as sweetening agents are showed below:

Table 1 Ingredient weight for white bread production

Ingredients	Quantity (g)	Percentage
Wheat Flour	500	52.6
Sugar	100	10.5
Salt	10	1
Yeast	10	1
Inverted sugar Syrup	95	9.9
Potable Water	235	24.6
Tablet	2	0.4

Table 1 presents the ingredients and their weight in gram and equivalent percentages used in the formulation of white bread sweetened with raw sugar and inverted sugar syrup.

Straight dough method (SDM)

The straight dough method was adopted for this study (Figure 1); it is the method in which all the ingredients are mixed together in a single batch of dough. Salt and sugar were dissolved in water and added to the flour before Yeast was added; then mixing was continued until the dough became elastic and smooth in appearance. Fermentation was conducted for two to five hours. The dough was divided, weighed, kneaded, panned, oiled, proofed and baked.[17,19]

Nutritional profiling of white bread (wb) samples

The nutritional profiling of the WB samples was determined using Nutritional Electronic Scales (Model No.VC-10104E, Coventry, UK).[4] This was conducted by placing on the equipment of known weight of WB sample (69g) each sweetened using ISS and of bread sample sweetened using RS and a review button was controlled according to instruction in the manual.[4] The results were digitally displayed on the screen of the Nutritional Electronic Scale.

Sensory evaluation of white bread samples

10 sensory panelists were served with coded samples of WB using the designed 9-Point Hedonic Scale Questionnaire to generate data. They were to assess the sample in terms of colour, aroma, texture, taste (mouth-feel) and overall acceptability. The panelists were also served with potable water so that they could rinse their mouth after tasting each of the samples.[18]

Statistical analysis of data generated on wb samples

The data obtained from the sensory evaluation were analyzed using these tools of statistics including T-Test and Ranking.[18]

Specific volume of white bread samples

The mass of WB samples was determined and their respective volumes were estimated using seed displacement method. A rectangular wooden box was used for this analysis. The box was filled with cleaned Millet seeds and was leveled in which the WB was placed in the same box and was filled with the measured Millet and leveled. The volume of the remaining Millet seeds from the same measured seeds was taken as the volume of the loaf of both samples of WB.[10]

$$\text{Volume of WB loaf } \left(\text{cm}^3\right) = W_2 \times \frac{V_1}{W_2}$$

Where:

W_1 = Weight of the seeds that filled the container

W_2 = Weight of the displaced seeds

V_1 = Volume of the container

Specific Volume (cm^3/g) = V/W

V = Volume of loaf

W = Weight of the loaf

Results and discussions

This part of the study presents and discusses the results of data generated and statistically analyzed from the sensory evaluation and nutritional profile respectively conducted on the two samples of WB sweetened with ISS coded 213 and sweetened with RS coded 215 (Tables 2 to 6).

Citation: Mohammed SF, Shuaibu J, Mohammed AD. Effect of inverted sugar syrup and raw sugar on the quality and sensory acceptability of white bread production. *MOJ Food Process Technol.* 2025;13(1):88–92. DOI: 10.15406/mojfpt.2025.13.00328

Table 2 Nutritional profile and specific volume for both 213 and 215 of WB Samples

Parameters	Sample 213	Sample 215
Calorie	180.88	186.3
KJ	757.43	780.13
Fat (g)	2.244	1.863
Saturated fat (g)	0.9	0.414
Cholesterol (mg)	0	0
Sodium (mg)	463.08	0.414
Carbohydrates (g)	34.408	38.226
Protein (g)	5.168	6.624
Fat (%)	10.9	8.8
Saturated fat (%)	0.204	1.9
Carbohydrates (%)	72.2	77.9
Protein (%)	11.4	14.2
Specific Volume (cm^3/g) 4.90	4.9	4.7

Table 3 T-test result for day one for both 213 and 215 White Bread Samples

Parameters	T-cal	T-tab	Remarks
Taste	0.869	2.262	NSD
Colour	0.961	2.262	NSD
Texture	-2.083	2.262	NSD
Aroma	-2.777	2.262	NSD
Overall Acceptbility	1.298	2.262	NSD

Table 4 T-test result for day two for both 213 and 215 WB

Parameters	T-cal	T-tab	Remarks
Taste	1.83	2.262	NSD
Colour	0.086	2.262	NSD
Texture	3.96	2.262	NSD
Aroma	-3.521	2.262	NSD
Overall Acceptbility	-1.298	2.262	NSD

Table 5 T-test result for day three for both 213 and 215 WB Samples

Parameters	T-cal	T-tab	Remarks
Taste	-5.343	2.262	NSD
Colour	-8.219	2.262	NSD
Texture	1.29	2.262	NSD
Aroma	-5.94	2.262	NSD
Overall Acceptbility	-11.11	2.262	NSD

Table 6 T-test result for day four for both 213 and 215 WB Samples

Parameters	T-cal	T-tab	Remarks
Taste	-6.201	2.262	NSD
Colour	-1.694	2.262	NSD
Texture	-7.142	2.262	NSD
Aroma	-9.09	2.262	NSD

Keys and codes: '213' stands for WB sweetened using Inverted Sugar Syrup, while **'215'** stands for WB sweetened Raw Sugar. The Table 2 presents the nutritional profile of both samples of WB, respectively.

In this study, the two samples of WB coded 213 and 215 prepared were subjected to nutritional profiling (Table 2). The results showed that fat content was 2.244g and 1.863g for saturated fat 0.9g and 0.414g, the cholesterol level was found to be zero (i.e. 0.00 mg) for both samples; the Sodium content was 463.08mg and 414.00mg, the Carbohydrate was 34.408g and 38.22g, for Protein we have 5.168g and 6.624g for WB sample 213 and sample 215, respectively. Also the nutritional profile in percentage results for Fat was 10.9% and 8.8%, for saturate fat it was 0.204% and 1.9%, the Carbohydrate was 72.2% and 77.9%, and Protein 11.4% and 14.20%, respectively. Nonetheless, both samples of WB have similar nutritional profiles, but exhibited slight difference in the contents of calories, fat, saturated fat, sodium, carbohydrate and protein values; hence indicating that the sweeteners do not have much influence on the nutritional profile of both samples of WB, respectively.

Also, the Table 2 presents the specific volumes of samples of WB sweetened using ISS and RS. (There is slight difference of 4.90 – 4.70 = 0.2). In this study, Table 2 shows the specific volume of the samples of WB sweetened with RS and ISS suggesting that the results obtained from the two samples of WB are in agreement with the specific volume (i.e. 4.00 cm^3/g) of good quality baked bread as reported by.[10] The results showed that samples 215 and 213 have specific volumes of 4.70 cm^3/g and 4.90 cm^3/g, respectively which is an indication that the wheat flour has good baking quality; although sample 213 shows a slight difference of 0.2 cm^3/g in comparison to sample 215.

Keywords: NSD: no significant difference and **SD:** significant difference

Table 3 presents the results of the analyzed sensory analysis data collected from the judges of sensory panelists for Day 1.

After the production of the two samples of WB; they were kept under observation for four (4) days consecutively, and each day the sensory parameters of the both samples were evaluated using same set of sensory panelists conducting the sensory analysis for four days consecutively. The results obtained were subjected to statistical analysis using the student T-test, which are presented in Tables 3 to 6 for four days, respectively.

Table 4 presents the results of the analyzed sensory analysis data collected from the judges of sensory panelists for Day 2.

Table 5 presents the results of the analyzed sensory analysis data collected from the judges of sensory panelists for Day 4.

Table 6 presents the results of the analyzed sensory analysis data collected from the judges of sensory panelists for Day 4.

Table 3 shows the results of sensory evaluation for Day 1 which indicated that there were no significant difference in both samples of the WB in terms of their taste (mouth-feel), colour, texture, aroma and overall acceptability, with reference to T-calculated and T-tabulated, respectively ($P < 0.05$). And Table 4 shows the results of the sensory analysis for Day 2, which also indicated that there were no significant difference in both samples of the WB in terms of their taste, aroma, color and overall acceptability but there is a significant difference in the texture ($P < 0.05$) because T-calculated (3.960) is higher than the T-tabulated (2.262) ($P < 0.05$). While Table 5 shows the results of the sensory analysis for Day 3 which indicated that there was no significant difference in both samples of the WB in term of their taste, texture, colour, aroma and overall acceptability ($P < 0.05$). Table 6 shows the results for sensory analysis of Day 4, which shows that there were no significant differences in both samples of the WB in terms of their taste, texture, colour aroma and overall acceptability, with reference to T-calculated and T-tabulated ($P < 0.05$). However, sample 213 was ranked best over sample 215 ($P < 0.05$).

Conclusion

At the end of this study we have been able to establish the fact that ISS can be used as a sweetener for dough preparation intended for WB production, and because of this discovery it should be added to the list of sweetening agent for WB production. This is owing to the fact that about 45% raw sugar (RS) reduction was established in this study and yet the expected sweet taste of WB is noticeable by the Panel of Judges. Also, the samples of WB produced using ISS exhibited shelf-life stability for the period in which they were subjected to sensory evaluation exercise. Also, other important discoveries of this study include the reduction in times of fermentation and proofing of the dough and as well the appealing sensory attributes of sample 213 especially its texture and colour were found soft and attractive than the sample 215 sweetened with the RS.

Acknowledgements

The corresponding author of this study sincerely appreciate the Management of Sky Crown Bakery, Gusau, Zamfara state, Nigeria for allowing them to use the Facility to up-scale this newly developed baking process during this study. Also, I will use this medium to sincerely appreciate the Management of Alfijir Bakery and Confectionery Nigerian Limited Gusau, Zamfara state, Nigeria for accepting to adopt and use this new baking process for mass production in the production of their White and coloured breads, respectively.

Also, this developed New Baking Process is on the process of Patenting; hence no person or group of persons companies is/are allowed to use the Recipes formulation and the Developed Process reported in this study. However, interested captains of food industries and/or person(s) can consult the corresponding author for business engagement and details.

Conflicts of interest

Authors declare no conflict of interest in the cause of this study. And all authors have read and agreed to publish this study in MOJ Food Processing Journal with the knowledge of the Management team of our institution; and this document is not submitted for publishing to any other Publishing body. However, this study was conducted as personal research without any funding (sponsorship) from any agency of government locally and/or abroad.

References

1. Mercuri B. *American sandwich*. Gibbs Smith Publications. 2009:1–42.
2. Cauvain S, Yong N. Improving the control of staling in frozen bakery products. *Food Science Technology*. 2001;9(1):56–61.
3. Adebowale OJ, Arowona MO, Adelani AI. Comparative effects of ascorbic acid and aframomum danielli (spice) on bread making during storage. *Nigerian Institute of Food Science and Technology (NIFST) Book of Proceedings of the* 33rd *Annual Conference at Yola* Adamawa state, Nigeria. 2009
4. Shuaibu J. Effect of inverted sugar syrup and raw sugar on the quality and safety of white bread production. HND Project Report submitted to the Department of Food Technology, Federal Polytechnic, Kaura Namoda, Zamfara state, Nigeria. 2021
5. Kent NL. T*echnology of cereals.* London: Paragon Press. 1984:221
6. Killby P. A Handbook on bread and confectionaries. *Federal Institute of Industrial Research Oshodi (FIIRO) Lagos*. 1985:11–15.
7. Dorrey W. Baking technology in bread making. *American Institute of Baking Kansea City*. 1995;1:5-17, 20–51,108–126.
8. Wood BJ. *Microbiology of fermented foods*. Champam Halls. 1989;1:176
9. Kurtzmann CP, fellow JW. *Yeast systematic and phylogenic implication of molecular identification methods studies in ecology*. London: Springer. 2006:11–30.
10. Murano PS. *Understanding food science and technology*. USA: Thompson Wadsworth Publishers. 2003:22–29.
11. Kennet FK, Krientuild C. *Ornate world history of food-sugar*. London: Cambridge University Press. 2012
12. Anonymous KC. *Ingredients potassium bromate*. 2022.
13. Ibitoye, F. *The Technology of bread making and flour confectionery*. 1st ed. London UK: Macmillan Publishers Ltd; 2008:226–230.
14. Gray JA, Bamiller JN. Bread staling: Molecular basis and comprehensive review. *Food Science and Food Safety*. 2003;2(1):1–21.
15. Fuhrman J. *The end of dieting.* harper one collin press. 2014:101–102.
16. Mohammed SF. effect of different ratios of ginger solution concentrations on the quality of millet-based kunun-zaki. *MOJ Food Processing & Technol*. 2018;6(6):469–475.
17. Badifu GI, Akaa O. Evaluation of shear fat performance as a shortening agent in bread making. *Journal of Food Science and Technology*. 2001;28:149–151.
18. Ihekoronye IA, Ngoddy PO. Integrated food science and technology for the tropics. 2nd ed. London UK: Macmillan Publishers Ltd. 1985.
19. Gisslen B. *Professional baking, hand book.* New Jersey. Wiley Press Ltd. 2004:7–20.
20. Onyekwere OO. *A handbook on bread and confectionaries*. FIIRO Lagos. 1985:7–142.