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Effect of Malting on the Chemical Constituents, Anti-nutrition Factors, and Ash Composition of Two Sorghum Cultivars (Feterita and Tabat) Grown in Sudan

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Abstract: Investigation showed that effect of malting on the chemical constituent, anti nutrition factors and ash composition of sorghums as follows ; Moisture content and crude fiber increased with increasing the malting days, no significant change in protein and oil content, slight change in ash content and carbohydrates content decreased with increasing the malting days. In addition, tannin and phytic acid increased with increasing the malting days. While minerals content decreased with increasing the malting days.

Key words: Malting, Tabat, Feterita and Chemical composition

INTRODUCTION

Sorghum and millet are significant contributes to protein and energy requirement for millions of people especially for poor persons in Africa and Asia. Sorghum is adapted to a wide range of ecological condition and can be grown under unfavorable condition because it is tolerate to adverse conditions such as hot and dry, also in areas of high rainfall, water logging, drought, poor fertility and salinity soil. Martin[11] suggested that sorghum culture started in Ethiopia or Sudan, Harlan[7] illustrated that sorghum arose across a large areas, where it was likely domesticated a number of times over a period of year. The greatest significance of sorghum grains lies on its major components and their chemical properties. Therefore, sorghum becomes well suited for food uses for example it is rich in antioxidant, gluten free, and attractive to people who's suffering from wheat allergy. The species of Sorghum bicolor covers a wide range of varieties from white and yellow to brown, red and almost black. According to Food Research Center - Sudan and other international institutions[8] stated that Sudanese sorghum varieties are found to be superior in quality especially in protein, but it is very low in tannin content. Bureng[3] stated that the white sorghum variety is widely grown in Sudan and it has low polyphenols content. The popular traditional Sudanese sorghum varieties are Feterita, Mayo, Safra, Dabar, white and red Mugad, Tetron, Tabat, Fukimustahi and Hageen Dura -1. A study conducted at Food Research Center-Sudan, mentioned that the Mayo is not suitable for mechanical processing due to its softness, in addition to that it has low nutritive value because its protein 9.5% compared with other sorghum grown in Sudan. The Safra sorghum characterized by white flour and 14 % protein and has a hard corneous kernel which suitable for mechanical decortications.

The Dabar sorghum has 10 – 12% protein and is widely grown, mechanically harvested, suitable for mechanical processing, and medium size which suitable for the pearled. The Feterita sorghum has high protein 13 – 14%, pigment under the per-carp resulting in dark colour of the flour and less suitable for modern milling. Tetron sorghum is smaller than Dabar sorghum, but its color is less bright. The white and red Mugud sorghum has 12 % protein, hard kernel, which easily breaks. Therefore, it is not suitable for new milling techniques. For the many of hybrids, 36 cultivars received ARC have 10 –12 % protein and four cultivars has 13% protein[3]. The new sorghum hybrids are suitable for modern milling because it has hard kernel The.Hageen Dura (1) sorghum has 12% protein, combinable and textural variety, poor flavor, creamy white in color and intermedium in size. Their grains are suitable for industrial milling and it has less traditionally uses due to its hardness. A major use of sorghum grains is in the preparation of food and soft drink in developing countries. In addition to that it is used for industrial or feed purpose. The main limiting factors for the spread of sorghum as human food as well as its ability to compete with wheat and wheat product is technologically of the milling and commercial processing[12]. The presence of biologically

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active components such as phytates and phenolic compounds are found to have adverse effects on intrinsic properties of proteins[16].

Malting is defined as traditional process, which used in Sudan for preparation the foods in certain occasions such as Hilomor in the fasting month (Ramadan month).

The objectives of this study are to investigate the effect of malting on the chemical constituents, anti nutrition factors and ash composition under three different stages of malting (3,5 and 7 days) to the Feterita and Tabat sorghum.

MATERIALS AND METHODS

Material: Two sorghum cultivars (Feterita and Tabat) were brought from ELGedrif area and harvested in November 2007.

Preparation of Samples: It was carried out according to method described by AOAC[2]. Two sorghum cultivars were subjected to malting by using traditional method for 3, 5, 7 days. Then the samples are crushed by electricity machine into fine powdered and prepared for chemical analysis according to AOAC[2].

Proximate Analysis: Moisture content, protein, oil, ash, crude fiber, total carbohydrates were determined according to AOAC[2]. Moisture of malting sample was determined by drying samples at 105 ºC overnight[2]. Total carbohydrates were obtained by subtraction of contents moisture, ash, oil, protein and crude fiber from 100.

Tannin Content: Quantitative estimation of tannins for each sample was carried out using modified vanillin-HCl methanol method as described by Price and Butler[14].

There is no useful standards curve for tannin in food, but the tanninic acid was used for preparation the standard curve of tannic acid. The standard curve of tannic acid was prepared according to AOAC[2] for measurement the concentration of tannin in our samples (plotting the concentration of tanninic acid (mg) against the corresponding reading of Spectrophotometer in Absorbance)

Phytic Acid Content: The phytic acid content was determined according to the method described by Wheeler and Ferrel[15]. The standard curve of phytic acid was prepared according to AOAC[2] for measurement the concentration of tannin in our samples (plotting the concentration of different Fe $(NO_3)_3$ (mg) against the corresponding reading of Spectrophotometer in Absorbance), the phytates phosphorus was calculated from the concentration of ferric iron assuming 4: 6 (irons: phosphorus molar ratio).

Ash Composition (Minerals): The minerals of dried samples were extracted according to Pearson's method[13] and were measured in a filtered 50 ml extraction solution by using Atomic absorption instrument.

Statistical Analysis: Three separate sub-samples from each origin sample were treated by complete randomized design and the average was recorded to analyses of variance (ANOVA)[9].

RESULTS AND DISCUSSION

Proximate Analysis: Table 1 shows the moisture content of non-malting Feterita sorghum is 4.7%, but moisture contents for the 3, 5 and 7 days malting are 5.5%, 6.6% and 6.8 %, respectively and the moisture content of non-malting Tabat sorghum is 5.5 %, but moisture content for the 3, 5 and days malting are 5.5%, 6.3% and 6.5 %, respectively. Results indicated that in both malting sorghums the moisture content increased with increasing the malting period compared with non-malting sorghum. This result deal with effect of malting on the moisture content is nearly comparable to those results obtained by Yousif and Magboul[17]. Protein content of non-malting Feterita sorghum is 12.69 %, but protein content for the 3, 5 and 7 days malting are 12.68 %, 12.67 % and 12.80%, respectively and the protein content of non-malting Tabat sorghum is 10.1 %, but protein content for the 3, 5 and days malting are 10.94 %, 10.94 % and 10.50 %, respectively. Results revealed that there is no changeable in protein content for both malting sorghums. Fat content of non-malting Feterita sorghum is 3.6%, but fat content for the 3, 5 and 7 days malting are 2.6 %, 2.7 %and 6.4 %, respectively and the fat content of non-malting Tabat sorghum is 2.6 %, but fat content for the 3, 5% and days malting are 2.5%, 3.4% and 3.7 %, respectively. Results indicated that the fat content firstly decreased at 3, 5 day malting and then start to increase at 7 days malting for Feterita sorghum, but it is firstly decreased at 3 day malting and then start to increase at 5, 7 days malting for Tabat sorghum. It means that there is change in fat content during the malting stages, because consumption of carbohydrate (sugars) is simple to uptake during the germination of seeds compared with fat consumption that to be slow in plant tissues. Results are agreed with those results obtained by Makki[10]. Ash content of non-malting Feterita sorghum is 1.45%, but ash content for the 3, 5 and 7 days malting are 1.40%, 1.45% and 1.40 %, respectively and the ash content of non-

Table 1: Proximate chemical composition of Feterita and Tabat cultivars (treated and control)

Sample	Feterita cultivar				Tabat cultivar			
	Control	3 days	5 days	7 days	Control	3 days	5 days	7 days
Moisture %	4.7	5.5	6.6	6.8	5.5	5.5	6.3	6.5
Protein %	12.69	12.68	12.67	12.80	10.1	10.94	10.94	10.50
Fat %	3.6	2.6	2.7	6.4	2.6	2.5	3.4	3.7
Ash %	1.45	1.40	1.45	1.40	1.75	1.25	1.45	1.35
Fiber %	0.70	0.80	1.23	3.23	0.75	0.88	1.24	2.24
Carbohydrate %	76.95	79.01	75.74	72.67	78.38	78.38	76.53	76.78

malting Tabat sorghum is 1.75 %, but ash content for the 3, 5% and days malting are 1.25%, 1.45% and 1.34%, respectively. Results indicated that there is slight change in ash content in both sorghum cultivars during malting stages. These results are agreed with those values reported by Yousif and Magboul[17]. Crude fiber of non-malting Feterita sorghum is 0.7%, but crude fiber for 3, 5 and 7 days malting are 0.8%, 1.23% and 3.23 %, respectively and crude fiber of non-malting Tabat sorghum is 0.75 %, but crude fiber for 3, 5 and days malting are 0.88%, 1.24% and 2.24%, respectively. It is indicated that in both cultivars crude fiber increased with increasing the period of malting compared with the non-malting sorghum. Crude fiber consists mainly of cellulose, lignin and hemicelluloses[5]. Therefore, it is increased with increase branny matter, which is not digestible for human being. In addition to that the increase in crude fiber might be attributed for building the dry matter during the growth and development of plant during the germination. The results of crude fiber are agreed with those results obtained by Dendy[4]. Carbohydrates content of non-malting Feterita sorghum is 76.95 %, but carbohydrates content for 3, 5 and 7 days malting are 79.01%, 75.74 % and 72.67%, respectively and the carbohydrates content of non-malting Tabat sorghum is78.38 %, but carbohydrates content for 3, 5 and days malting are 78.38 %, 76.53 % and 76.78 %, respectively. Results indicated that carbohydrates content in both sorghum cultivars decreased with increasing the period of malting because carbohydrate (sugars),during germination, is easily digestible for obtain the energy which required for growing the embryo within the seeds. These results are agreed with those results obtained by El-Tinay *et al.*[6].

Tannin and Phytic Acid: Table 2 shows Table 1 shows tannin content of non-malting Feterita sorghum is 4.60 mg/ 100g, but tannin content for 3, 5 and 7 days malting are 6.20 mg /100g, 10.0 mg /100g and 15.0 mg /100g, respectively and tannin content of non-malting Tabat sorghum is 1.6 mg /100g, but tannin content for 3, 5 and days malting are 2.0 mg /100g, 3.7 mg /100g and 5.3 mg /100 g, respectively. Results revealed that tannin content in both sorghum cultivars increased with increasing the malting period compared with non-malting sample. Tannin is concentrated in seed coat, which is not affected by germination, since the major food consumption was taken from the cotyledon. The remained cotyledon parts are less in weight compared with seed coat. Therefore, overall tannin content was increased. This result indirectly agrees with Ali[1] who reported that decortications decreased the tannin content. In addition to that the Feterita sorghum contained high quantity of tannin compared with Tabat sorghum. Phytic acid content of non-malting Feterita sorghum is 12.30 %, but phytic acid content for 3, 5 and 7 days malting are 19.00 %, 30.00 %and 46.00 %, respectively and phytic acid content of non-malting Tabat sorghum is 3.6 %, but phytic acid content for 3, 5 and days malting are 4.90 %, 11.0 % and 17.00 %, respectively. Results revealed that pepcatiry acid content in both sorghum cultivars increased with increasing the malting period compared with non-malting samples. This result might be attributed to during the germination the embryo consumes the nutritive values and consequently this leads to decrease amount of the nutritive values of grain, in addition to that it leads to increase phytic in the seed coat than inner parts of grain.

Ash Composition (Ca, Mg, K, Fe, Mn and Zn): Table 3 indicates calcium content of non-mating Feterita sorghum is 0.005 %, but calcium content for 3, 5 and 7 days malting are 0.003 %, 0.003 % and 0.002%, respectively. Whereas, calcium content of non-malting Tabat sorghum is 0.007 %, but calcium content for 3, 5 and 7 days malting are 0.002 %, 0.003 % and 0.002%, respectively. Magnesium content of non-malting Feterita sorghum is 0.96 %, but magnesium content for 3, 5 and 7 days malting are 0.91 %, 0.90 % and 0.87%, respectively. Whereas, magnesium contents of non-malting Tabat sorghum are 1.0 %, but magnesium content for 3, 5 and 7 days malting is

Table 2: Tannin and phytic acid of Feterita and Tabat cultivars (treated and control).

Sample	Feterita cultivar				Tabat cultivar			
	Control	3 days	5 days	7 days	Control	3 days	5 days	7 days
Tannin (Mg / 100g)	4.60	6.20	10.0	15.0	1.6	2.0	3.7	5.3
Phytic acid (%)	12.30	19.00	30.00	46.00	3.60	4.90	11.0	17.0

Table 3: Mineral contents of Feterita and Tabat cultivars (treated and control).

Sample	Feterita cultivar				Tabat cultivar			
	Control	3 days	5 days	7 days	Control	3 days	5 days	7 days
Ca %	5.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	7.0×10^{-3}	3.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}
Mg %	9.6×10^{-2}	9.1×10^{-2}	8.0×10^{-2}	7.8×10^{-2}	10.0×10^{-2}	9.8×10^{-2}	9.6×10^{-2}	5.8×10^{-2}
K %	1.4×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	1.7×10^{-2}	1.5×10^{-2}	1.3×10^{-2}	0.6×10^{-2}
Fe %	4.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	1.0×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	1.0×10^{-3}	1.0×10^{-3}
Mn %	9.0×10^{-4}	5.0×10^{-4}	4.0×10^{-4}	2.0×10^{-4}	7.0×10^{-4}	5.0×10^{-4}	3.0×10^{-4}	2.0×10^{-4}
Zn %	8.0×10^{-4}	5.0×10^{-4}	3.0×10^{-4}	1.0×10^{-4}	3.0×10^{-4}	2.0×10^{-4}	2.0×10^{-4}	8.0×10^{-5}

0.98 %, 0.97 % and 0.58%, respectively. Potassium content of non-malting Feterita sorghum is 0.16 %, but potassium content for 3, 5 and 7 days malting are 0.14 %, 0.13 % and 0.13%, respectively. Whereas, potassium content of non-malting Tabat sorghum is 0.17 %, but potassium contents for 3, 5 and 7 days malting are 0.16 %, 0.15 % and 0.06 %, respectively. An iron content of non-malting Feterita sorghum is 0.004 %, but iron content for 3, 5 and 7 days malting are 0.002 %, 0.001 % and 0.001%, respectively. Whereas, iron content of non-malting Tabat sorghum is 0.003 %, but iron content for 3, 5 and 7 days malting is 0.002 %, 0.002 % and 0.001%, respectively. Manganese contents of non-malting Feterita sorghum are 0.0009 %, but manganese content for 3, 5 and 7 days malting are 0.0005 %, 0.0002 % and 0.0001%, respectively. Whereas, manganese content of non-malting Tabat sorghum is 0.0007 %, but zinc contents for 3, 5 and 7 days malting are 0.003 %, 0.002 % and 0.001%, respectively. Zinc content of non-malting Feterita sorghum is 0.0008 %, but zinc contents for 3, 5 and 7 days malting are 0.0006 %, 0.0003 % and 0.0001%, respectively. Whereas, zinc content of non-malting Tabat sorghum is 0.003 %, but zinc contents for 3, 5 and 7 days malting are 0.002 %, 0.002 % and 0.0008%, respectively. Results indicated that calcium, magnesium, potassium, iron, manganese and zinc content decrease with increasing the malting periods. These results may be due to that mineral have vital role in germination and so they are intermitted in the growth of grain roots through their incorporation in cell wall and content formulation.

Conclusion: The long period for malting (more than 3 days) leads to decrease carbohydrate, minerals and increase tannin and phytic acid. In addition to that no significant change in protein Therefore, the nutritive value of malting Feterita and Tabat sorghum become low due to consumption the nutrients of sorghum by germ for its growth and development.

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REFERENCES

1. Ali, A.E., 2005. Effect of Decortications Method on Nutrient of Sorghum Grain.M.Sc.Thesis.Sudan Uni.For Sci. and Tech.Sudan.
2. A.O.A.C., 1990. Official Methods of Analysis 15th ed., Association of Official and Analytical Chemists. Washington, D.C.
3. Bureng P.L., 1995. Evaluation of sorghum cultivars for Kissra qquality.Sorghum millet improvement programmed. Annual Report 1994 / 1995. (ARC) Wad Medani, Sudan.
4. Dendy, D.A., 1995. Sorghum and Millet Chemistry and Food Technology. Published by the American

Association of Cereal Chemist. St. Paul, Minnesota, USA.
5. Eggum, B.O., L. Monawar, K.E Bach Knudsen, L. Munck and J. Axtell, 1981. Nutritional quality of whole and decorticated sorghum and sorghum food from Sudan.J.Cereal Sci., 1: 1227-137.
6. El-Tinay, A.H., A.M. Abdal-Gadir and M. EL-Hadai, 1979. Sorghum fermented Kisser bread .I. Nutritive value of Kissra.J.of Science Food and Agriculture, 30: 859-863.
7. Harlan, J.H., 1987. Socio-Economic Differentiation in the Neolithic. Sudan. Cambridge Monographs in Africa Archacaeology, 20, BAR International Series, and 350 Oxford University Press. Oxford.
8. ICRISAT, 1991. Sorghum research and Development Network for Asia. Report of consultative meeting to consider the establishment of sorghum research and development network for Asia. ICRISAT, Patencheru, Andhra Pradesh, 502324, India, 16 – 19. Sept.1991).
9. SAS, 1997. SAS / STAT User, Guide, Statistics ED.Cary N.C.
10. Makki, H.M., 1998. Production of protein enriched baby food from Sudanese starchy raw materials .Ph.D.Thesis, University of Vienna for Agricultural Science, Vienna, Austria.
11. Martin, J.H, 1970. History and classification of sorghum. In: Wallis and Press, W.M.(ends).Sorghum production and Utilization. The AVI Publishing Company. Inc., Westport Connection, pp: 1-27.
12. Perten, H., 1979.Milling of sorghum and millet – Sorghum Seminar on Production – Processing and Marketing FAO project PFL / SUD /001. Food Research Center, Shambat North, Sudan.
13. Pearson, H., 1970.Pearson's Chemical Analysis of Food.Edin., Egon. H.; Kirk, R.S.; London, New York. Eighth Edition.
14. Price, M.L. and L.C. Butler, 1987.Tannin and Nutrition. Station Bulletin No272. Agriculture Experiment Station. Purdue University, West Lafayette Indian
15. Wheeler, E.L. and R.E. Ferrel, 1971. A method for phytic acid determination in Wheat and Wheat fractions. Cereal Chem., (48): 312-320.
16. Yagoub, A.G., 2003. A biophysical study on Roselle (*Hibiscus sabdariffal*.) seeds total proteins of the traditionally fermented food. Thesis for doctorate degree of philosophy. Faculty of Agri. University of Khartoum.
17. Yousif, Y.B. and B.I. Magboul, 1972.Nutritive value of Sudan food stuffs. Part 1: Sorghum valgure Dura. Sudan J. Food Sci. and Techno. 4: 39-45.