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Effect of fermentation period on the chemical composition, in-vitro protein digestibility and tannin content in two sorghum cultivars (Dabar and Tabat) in Sudan

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ABSTRACT

Objective: In the present study, sorghum cultivars (Dabar and Tabat) were studied to assess the effect of fermentation on the chemical composition, tannin content and in -vitro protein digestibility.

Methodology and results: The cultivars were subjected to fermentation at 3, 5 and 7 hours at 32 ^{o}C according to the traditional method. The chemical composition of Dabar cultivar before fermentation was 6.5 % moisture, 10.9 % protein, 3.7 % fat, 1.8 % ash, 1.9 % crude fiber and 75.6% carbohydrates while for cultivar. Tabat was 5.5 % moisture, 10.10 % protein, 2.6 % fat, 1.75 % ash, 1.45 % fiber and 78.6 % carbohdrates.Taninin contents of unfermented Dabar and Tabat cultivars were found to be 0.22 and 1.6 mg/100g, respectively. In-vitro protein digestibility of the unfermented Dabar and Tabat cultivars was 44.6 and 36.8 %, respectively. The results revealed that chemical composition, tannin content and in-vitro protein digestibility of both cultivars were significantly affected by fermentation. Therefore, fermentation is an important method for increasing

in vitro protein digestibility of Dabar and Tabat cultivars from 44.6 to 79.3% and from 36.8 to 80.1%, respectively, while reducing the tannin content of Dabar and Tabat cultivars from 0.22 to 0.06% and 1.6 to 0.04 %, respectively. In addition, fermentation helps to improve the nutritional value of the sorghum. However, there is no highly significant difference in mineral content between the unfermented and fermented sorghum cultivars.

Conclusion and application of findings: Fermentation techniques should be applied in areas in which the sorghum crop sustains the lives of the poorest rural people.

Key words: Dabar, Tabat, cultivars, fermentation.

INTRODUCTION:

Sorghum (*Sorghum bicolor* L Monech) is one of the important staple foods for millions of people in the semi arid tropics of Asia and Africa. Sorghum is a cereal crop which contains a significant amount of toxic or anti nutritional substance. Most cereal crops contain amounts of phytates and enzyme inhibitor. Some cereals like sorghum and millet contain large amount of polyphenols and tannin (Salunkhe, 1990). Sorghum crop sustains the lives of the poorest rural people and will

continue to do so in the foreseeable future (FAO, 1995).

Sorghum is used for two distinct purposes as human food and animal feed. Sorghum is the fifth most important cereal in the world, being exceeded only by wheat, rice, maize and barley in that order (FAO, 1977). The leading sorghum production countries are USA, China, India, Nigeria, Mexico, Argentina, Sudan and Egypt Sorghum and millet are significant contributes to protein and energy requirement for million of people especially for poor person in Africa and Asia (Murwan and Amna, 2008). Sorghum nutritional quality is indicated mainly by its chemical composition and the presence of anti-nutritional factors such as tannin.

The major anti-nutritional effects of the tannin found in the animals and humans are diminished growth rate, protein digestibility and feed efficiency (Jumbundthan and Mertz, 1973, Muinidi *et al*. 1981). Animal or plants tissues subjected to the action of the microorganism and/or for the enzyme to give desirable biochemical changes and significant modification of food quality are referred to as fermented foods (Cambpell-platt, 1994). According to Steinkrans (1995) the traditional fermentation of foods serves several functions which included enrichment of the diet development of a diversity of flavor, aroma, and texture in food substrate, enrichment of the food substrate biologically with protein, essential amino acids, essential fatty acids and vitamins, detoxification during food fermentation processing, preservation of substantial amount of food through lactic acid, alcoholic, acetic acid and alkaline fermentation and decrease in cooking times, and fuel requirements.

The objective of this study was to evaluate the nutritional value and assess the effects of fermentation on the chemical composition, in-vitro protein digestibility and tannin content of two sorghum cultivars (Dabar and Tabat).

MATERIALS AND METHODS

Origin of sample: The samples (Dabar and Tabat) studied was obtained from the Department of Agronomy, Faculty of Agriculture, University of Khartoum. Experiments were conducted in the Biochemistry lab, Faculty of Science and Technology, Al Neelain University in 2003.

Analytical methods: The standard analytical method for the cereal crop have been described (AOAC, 1984). Minerals were extracted by the method described by Pearson (1981) and measured by atomic absorption spectrophotometer. The quantitative assays of tannin content was done as described by Price (1978), in vitro protein digestibility was assessed according to Manjula and John (1991), while the traditional fermentation method was carried out according to El Tinay (1979).

Data analysis: The collected data were analyzed according to the standard statistical procedure described by Gomez and Gomez (1984).

RESULTS AND DISCUSION

Results (Table 1) indicate the moisture contents of unfermented Dabar and Tabat cultivars were 6.2 and 5.5 %, respectively. These findings are not in agreement with those reported by Awad AlKareem (2002), but it is also found to be out of range compared to that given by Arbab and El Tiny (1993). Meiner (1979) stated that the variation in moisture content of sorghum cultivars is affected by several factors such as humidity, cultivars and environmental conditions. In this study the moisture content of fermented Dabar and Tabat decreased with increasing fermentation time. The protein contents of unfermented Dabar and Tabat were 6.5 and 10.1 %, respectively. These results are within the reported by Yousif and Magboul (1972). Waggle (1972) stated that the variation in protein content of sorghum cultivars is affected by sowing date, seed size and temperature. The protein content of fermented Dabar and Tabat was slightly changed when the fermentation time increased. Fat contents of unfermented Dabar and Tabat were 3.7 and 2.6 %, respectively and slightly changed with increasing fermentation time. These findings were within the range obtained by El Tiny (1979). (Table 1)

Table 1 composition of sorghum cultivars Dabar and Tabat cultivars in Sudan.

Parameters	Dabar Control	Fermentation period (hours)			Tabat Control	Fermentation period (hours)		
		3	5	7		3	5	7
Moisture	6.5	5.50	5.0	4.0	5.5	5..0	4.5	3.5
Protein	10.9	10.0	9.57	9.50	10.1	10.94	10.94	10.50
Fat	3.7	2.6	2.7	2.0	2.6	2.5	2.4	2.1
Ash	1.8	1.40	1.45	1.40	1.75	1.25	1.45%	1.35%
Fiber	1.9	1.80	1.23	1.18	1.45	2.24	1.24%	0.8%
Carbohydrate	75.2	78.7	80.05	81.02	78.6	78.07	79.47	81.75

* All values are % and each value is average of three replicates expressed on dry weight basis.

Ash content of unfermented Dabar and Tabat 1.8and 1.755, respectively and decreased with fermentation time. These results agree with those reported by Abd ALRahman (2000). The crude fibers of unfermented Dabar and Tabat were 1.9 and 0.75 %, respectively, and increased the fermentation time. These finding was lower than reported by Awad AlKareem (2002). The reduction in crude fibers may be attributed to activities of microorganisms during fermentation. The carbohydrates content of unfermented Dabar and Tabat were 75.6 and 78.39 %, respectively and it decreased with fermentation time increased.

Results (Table 2) indicate that tannin contents of unfermented Dabar and Tabat were 0.22 mg/100g and 1.6 mg/100g respectively. It is observed that the tannin content of fermented Dabar and Tabat was reduced from 0.22 to .06 mg/100g and from 1.6 to .4 mg/100g, respectively. Starky (1968) stated that the reduction in tannin contents of sorghum cultivars might be attributed to the activities of microorganism during fermentation. The in-vitro protein digestibility of unfermented Dabar and Tabat were 44.0 and 36.3 %, respectively, and increased as fermentation time increased. Babik and El Tiny (1993) stated that variation in the in-vitro protein digestibility of sorghum cultivars is affected by genotype and tannin contents. Chavan (1988) reported that the content and quality of protein of sorghum cultivars may be improved by fermentation. Graham (1980) indicted that the traditional Sudanese techniques markedly enhanced the protein and energy digestibility for grains of two sorghum cultivars.

Table 2 Tannin and in-vitro protein digestibility acid of sorghum cultivars Dabar and Tabat in Sudan.

Parametres	Dabar Control	Fermentation period (hours)			Tabat Control	Fermentation period (hours		
		3	5	7		3	5	7
Tannin (mg / 100g)	0.22	0.18	0.12	.06	1.6	0.80	0.45	0.04
IVPD % *	44.6	60.5	74.5	79.3	36.8	47.6	65.8	80.1

* IVPD: in-vitro protein digestibility , Each value is average of three replicates expressed on dry weight basis

Results (Table 3) showed that the calcium content of unfermented Dabar was 1.6 mg/100g while at 3, 5 and 7, respectively. Calcium content of unfermented Tabat was 2 mg/100g while in fermented Dabar. The magnesium content of unfermented Tabat was 9.9 mg/100g and did not changed with fermentation.

Table 3 Mineral contents of sorghum cultivars Dabar and Tabat in Sudan.

Minerals	Dabar Control	Fermentation period (hours)			Tabat Control	Fermentation period (hours)		
		3	5	7		3	5	7
Ca	1.5	1.6	1.5	1.8	2.0	1.9	2.0	2.2
Mg	9.6	9.0	8.9	8.6	9.9	9.7	9.7	9.7
K	14	13	14	14	16	16	16	15
Fe	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Mn	0.2	0.3	0.3	0.2	0.02	.001	0.01	0.01
Zn	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01

Values are in mg/100g and each value is average of three replicates expressed on dry weight basis.

The potassium content of unfermented Dabar was 14 mg/100g and was not affected by fermentation. Potassium content of unfermented Dabar was 0.02 mg/100g and remained fairly constant even after fermentation. The manganese content of unfermented Tabat was 0.02 mg /100g while fermented Dabar it was similar (0.01/100g) at 3, 5 and 7 hours. The zinc content of unfermented Dabar was 0.01 mg/100g while zinc content of fermented Dabar at 3, 5 and 7 hours was similar (0.02mg/100). For cultivar Tabat the zinc content before and after fermentation was constant at 0.01 mg/100g. These results indicated that there is no significant difference in minerals content between unfermented and fermented Dabar and Tabat cultivars.

CONCLUSION

Fermentation technique improved the nutritional value of the sorghum because it leads to reduced tannin, increased in-vito protein digestibility and minerals content of fermented products

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