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Effect of fermentation on tannin content and *in-vitro* protein and starch digestibilities of two sorghum cultivars

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Two sorghum cultivars — Safra (intermediate in tannin, 0·65%) and Cross 35:18 (high in tannin, 1·36%) — obtained from Wad Medani Research Station were used in this study. Investigations showed that *in-vitro* protein digestibility (IVPD) of untreated seeds were 73·6% and 70·7%, respectively, and *in-vitro* starch digestibilities (IVSD) were 32·3% and 33·8% for Safra and Cross 35:18 cultivars, respectively. The two cultivars were fermented for 14 h and the tannin content, IVPD and IVSD were determined at 2-h intervals. The tannin content decreased from 0·65% to 0·24% and from 1·35% to 0·52% for Safra and Cross 35:18 cultivars, respectively. The IVPD increased from 73·6% to 84·9% and from 70·7% to 80·1% for the two cultivars, respectively. The IVSD increased from 32·3% to 45·2% and from 33.8% to 47·0% for the two cultivars, respectively.

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth largest cereal crop in the world and is grown throughout Asia, Africa and North America (Deyoe & Robinson, 1979). It is the most important cereal crop in Sudan. Van Buren and Robinson (1969) reported that tannins affect the growth of animals in three main ways: they have an astringent taste, which affects palatability and decreases feed consumption; they form complexes with proteins and reduce its digestibility and they act as enzyme inactivators. All these factors result from the interaction of tannins and proteins to form soluble and insoluble complexes, an interaction that depends primarily on relative proportions of phenol and protein.

The natural fermentation of meals of sorghum (Au & Fields, 1981; Kazanas & Fields, 1981) has been reported to increase the relative nutritive value and availability of limiting amino acids.

Sudanese people consume sorghum in a fermented form mainly as Kisra bread or Asida porridge. Kisra is a fermented sorghum flour which is baked on a hot plate to form thin sheets of bread (El Tinay *et al.*, 1979).

This study was conducted to determine the effect of fermentation on tannin content and *in-vitro* protein and starch digestibilities of two sorghum cultivars varying in their tannin content.

MATERIALS AND METHODS

Materials

Two sorghum cultivars, Safra and Cross 35:18, from the Wad Medani Research Station were cleaned and ground to pass a 0·4 mm screen.

Preparation of dough

Fermented dough was prepared in the traditional domestic way. Sorghum flour (2 kg) was mixed with 4 litres of water in a round earthenware container. Previously fermented dough (600 g) was then added to the mixture of flour and water to act as a starter. After thorough mixing, samples were taken at 2-h intervals until the end of fermentation which was terminated after 14 h (pH 3·8–3·9) at ambient temperature (30 ± 2°C). Samples were dried in an air oven at 70°C and were finely ground.

Moisture, protein, starch and tannin analysis

Moisture and protein (N × 6·25) were determined according to AOAC (1984). Starch was determined by the method of dispersal in $CaCl_2$, followed by iodine spectrophotometry (Kerr, 1950). Tannins were estimated by the procedure of Price *et al.* (1978). The results were expressed on a dry matter basis.

In-vitro protein digestibility (IVPD)

The IVPD was determined according to the method of Maliwal (1983) with modifications by Manjula and John (1991).

In-vitro starch digestibility (IVSD)

The IVSD was determined according to the method of Singh *et al.* (1982).

Statistical analysis

Each sample was analysed in triplicate and the figures were then averaged. Data was assessed by analysis of variance (ANOVA) (Snedecor & Cochran, 1987) and by Duncans's multiple range test with a probability $P \leq 0.01$ (Duncan, 1955).

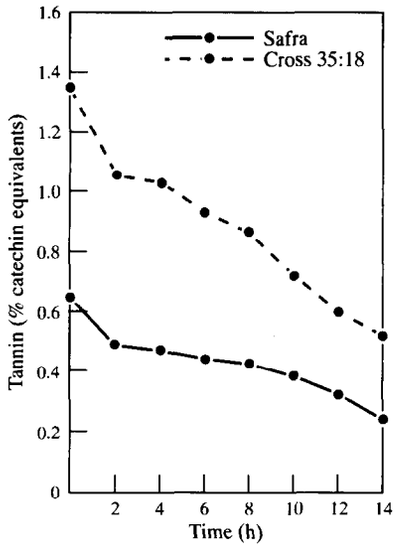

Fig. 1. Effect of fermentation on tannin content.

RESULTS AND DISCUSSION

Fermentation and tannin content

The effect of fermentation on tannin content (expressed as catechin equivalents) of Safra and Cross 35:18 cultivars is shown in Fig. 1. Fermentation for 14 h was found to cause a decrease in tannin content from 0·65% to 0·24% and from 1·35% to 0·52% for Safra and Cross 35:18 cultivars, respectively. The percent decreases in tannin content in the first 2 h were 24·3% and 22·3% for the two cultivars, respectively, then the decrease in tannin content levelled off during the first 8 h of fermentation and thereafter the percent decreases were 63·1% and 61·4% for the two cultivars, respectively, at the end of fermentation. Results indicated that fermentation of sorghum dough caused a highly significant ($P \leq 0.01$) decrease in tannin content. Romo-Parada *et al.* (1985) reported a 92% reduction of tannin content of a high tannin sorghum cultivar as a result of fermentation.

Fermentation and IVPD

The IVPD of Safra and Cross 35:18 cultivars fermented dough is shown in Table 1. Fermentation was found to cause a highly significant ($P \leq 0.01$) improvement in IVPD for the two cultivars. The increases were from 73·6% to 84·9% and from 70·7% to 80·1% for the two cultivars, respectively. Results indicated that fermentation of sorghum dough caused a highly significant increase in IVPD. This improvement in IVPD could be attributed to tannin degradation by microorganisms. Romo-Parada *et al.* (1985) reported that

Table 1. *In-vitro* protein digestibility (IVPD) and *in-vitro* starch digestibility (IVSD) of two sorghum cultivars fermented dough (means ± SD)

Fermentation period (h)	Safra			Cross 35:18		
	pH	IVPD (%)	IVSD (%)	pH	IVPD (%)	IVSD (%)
0	6·78	73·6 (±0·28)h	32·3 (±0·22)h	6·53	70·7 (±0·05)h	33·8 (±0·10)h
2	5·68	75·3 (±0·01)g	34·6 (±0·14)g	5·32	71·8 (±0·06)g	36·1 (±0·12)g
4	4·9	77·2 (±0·07)f	36·7 (±0·23)f	5·15	72·8 (±0·06)f	38·4 (±0·02)f
6	4·7	77·8 (±0·00)e	38·4 (±0·24)e	5·02	73·7 (±0·03)e	40·0 (±0·01)e
8	4·3	79·1 (±0·08)d	39·7 (±0·14)d	4·81	75·1 (±0·28)d	42·6 (±0·21)d
10	4·15	81·9 (±0·05)c	41·0 (±0·07)c	4·52	77·1 (±0·28)c	45·0 (±0·16)c
12	3·95	84·4 (±0·05)b	43·4 (±0·20)b	4·39	79·1 (±0·07)b	46·2 (±0·15)b
14	3·90	84·9 (±0·18)a	45·2 (±0·16)a	3·83	80·1 (±0·12)a	47·0 (±0·02)a

Means not sharing a common following letter in a column are significantly different at $P \leq 0.01$ as assessed by Duncan's multiple-range test.

natural fermentation of sorghum improves the IVPD. Chavan *et al.* (1988) found that the IVPD of sorghum grain increased markedly by fermentation for 24 h and this increase in protein availability to enzymic breakdown after fermentation can be attributed to the partial degradation of complex storage proteins into more simple and soluble products.

Fermentation and IVSD

The IVSD of Safra and Cross 35:18 sorghum cultivars fermented dough is shown in Table 1. Fermentation was found to cause a highly significant ($P \leq 0.01$) increase in IVSD for the two cultivars. The increases were from 32·3% to 45·2% and from 33·8% to 46·0% for Safra and Cross 35:18 cultivars, respectively. The results indicated that fermentation of sorghum dough caused a highly significant increase in IVSD. Kazanas and Fields (1981) reported an increase in protein and carbohydrate availability due to fermentation.

These results indicated that natural fermentation of sorghum dough at (30 ± 2°C) caused a highly significant improvement in its nutritive value by decreasing the tannin content, improving IVPD and IVSD.

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