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The Effects of Germination of Low - Tannin Sorghum Grains on its Nutrient Contents and Broiler Chicks Performance

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Abstract: Sorghum (Fetrita) was soaked in water for 12 hours, germinated for 3, 5 and 7 days in a shadow under cover and dried by sunlight for 2 - 3 days. Crude protein and tannin content of germinated sorghum were determined and it's metabolizable energy value was calculated. Four isonitrogenous and isocaloric diets were formulated using Fetrita germinated for zero (control), 3, 5 and 7 days each in a starter and a finisher diet and were fed to unsexed commercial broiler chicks (Hypeco) for 42 days. The results showed that by seventh day of germination crude protein increased by 31%, tannin content increased by 100% and reached toxic level and metabolizable energy was decreased by 6%. Germination of low - tannin sorghum for 3 days had no effect on feed intake, body weight gain and feed conversion ratio of broiler chicks throughout the whole period. Increase in days of germination decreased growth of broiler chicks. It seems that germination of low - tannin sorghum grains has little beneficial effects on broiler chicks' performance and it increased tannin concentration.

Key words: Sorghum, germination, tannin and broiler

Introduction

Sorghum is deficient in lysine content. Hulse *et al.* (1980) noticed that first limiting amino acid in sorghum is lysine as in most cereals. Also Wall and Blessin (1970) reported that the amino acids composition of the total protein in sorghum is the same to that of corn and other cereals, where lysine is the most limiting amino acid. These studies showed that lysine content is of a crucial importance in diets composed mainly of cereals (Jansen, 1972). In addition to the insufficient amount of lysine, sorghum grains contain an antinutritive factor called tannin. Tannins are polyphenols that occur widely in plant - based food. They are considered as to be part of the plant defense system against environmental stressors. Herstad (1980); Barry and Manley (1984) found that high - tannin sorghum decreased feed consumption of broiler chicks. Elkin *et al.* (1978) and Luis and Sullivan (1982) found frequent use of high - tannin sorghum diet decreased growth rate and led to poor feed conversion ratio of broiler chicks. Musharaf and Latshaw (1991) reported that intermediate - tannin sorghum (1.35% CE) increased incidence of leg abnormalities when compared with low - tannin sorghum.

Bennick (2002) noticed that tannins have a number of effects on animals, including growth - rate depression and inhibition of digestive enzymes. Hassan *et al.* (2003) reported that high - tannin sorghum caused a highly significant reduction in the weight gain and feed intake of broiler chicks compared to low - tannin sorghum and increased the feed conversion ratio.

Various processing methods have been employed to improve the nutritive value of cereal grains, such as tannin extraction (Musharaf and Latshaw, 1991) germination or malting (Shayo *et al.*, 2001) who concluded that germination was superior to the other processing methods in improving the nutritional and functional qualities of sorghum. Malting increased the protein, lysine and reduced tannin contents of sorghum (Wu and Wall, 1980; Okoh *et al.*, 1989 and FAO, 1995). Idris *et al.* (2005) reported that malting of low - tannin sorghum reduced tannin content of seeds. Hamid (2001) found that germination of low - tannin sorghum increased protein content of grains. Falfiolu *et al.* (2006) noticed that average weight of growing hens increased with increasing levels of malted sorghum sprout.

This study was performed to evaluate the efficiency of germination method in improving the nutritive value of low - tannin sorghum for broiler chicks.

Materials and Methods

Low - tannin sorghum (Fetrita) was soaked in water for 12 hours, germinated for 3, 5 and 7 days in a shadow under cover and dried by sunlight for 2 - 3 days. Germination process was performed as commonly practiced at home to prepare traditional local beverage (Hulu - mur) used during the Holy month of Ramadan. Crude protein of germinated and ungerminated sorghum was determined by micro - Kjeldhal method. Tannin content was determined by the modified vanillin - HCl method of Price *et al.* (1978). Metabolizable energy

Table 1: Composition, calculated and determined analysis of experimental diets (dry matter)

	Ungerminated Fetrita		3-days germination		5-days germination		7-days germination	
Ingredients	Starter %	Finisher %	Starter %	Finisher %	Starter %	Finisher %	Starter %	Finisher %
Sorghum (Fetrita)	54.00	57.10	54.00	57.10	54.00	57.10	54.00	57.10
Groundnut cake	24.00	23.96	16.50	18.00	11.00	17.13	-	-
Sesame cake	14.20	05.20	20.25	09.22	19.50	05.98	24.50	15.08
Wheat bran	02.66	09.00	04.23	11.00	10.40	15.00	16.43	23.13
Oil	01.50	01.50	01.50	01.50	01.50	01.50	01.50	01.50
Bone meal	01.55	00.86	01.38	00.73	01.27	00.71	01.04	00.35
Oyster shell	00.97	01.37	01.06	01.45	01.17	01.50	01.33	01.74
Lysine – HCl	00.51	00.38	00.53	00.41	00.59	00.45	00.66	00.54
DL – Methionine	00.11	00.13	00.05	00.09	00.07	00.13	00.04	00.06
Vitamin (Premix) *	00.25	00.25	00.25	00.25	00.25	00.25	00.25	00.25
Salt	00.25	00.25	00.25	00.25	00.25	00.25	00.25	00.25
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Determined								
Crude protein (%)	23.55	20.55	23.78	20.46	23.70	20.66	23.86	20.85
Lysine (%)	01.20	01.00	01.20	01.00	01.20	01.00	01.20	01.00
Methionine (%)	00.50	00.41	00.50	00.41	00.50	00.41	00.50	00.41
Calcium (%)	01.00	00.90	01.00	00.90	01.00	00.90	01.00	00.90
Available phosphorous (%)	00.45	00.35	00.45	00.35	00.45	00.35	00.45	00.35
Calculated metabolizable energy (MJ/Kg)	13.41	13.33	13.25	13.12	13.36	13.18	13.08	12.97

*Supplied per Kg of diet: vitamin A, 3500 IU; vitamin D3, 1300 IU; vitamin E, 11 IU; vitamin B12, 0.009 mg; riboflavin, 2.2 mg; niacin, 66 mg; panthothenic acid, 7 mg; choline, 1700 mg; thiamine, 2 mg; pyridoxine, 3 mg; biotin, 0.4 mg; folic acid, 0.4 mg.

Table 2: Changes in protein content (%), metabolizable energy (MJ/Kg) and tannin content (% as catechin equivalent) of sorghum seeds as a result of germination for 3, 5 and 7 days

	Ungerminated Fetrita	3-days germination	5-days germination	7-days germination
Crude protein (%)	13.10	12.95	15.42	17.15
Metabolizable energy (MJ/Kg)	14.34	13.82	14.06	13.37
Tannin (%)	00.34	00.59	00.54	0.68
% Changes in tannin contents	00.00	74.00	59.00	100.00

values of sorghum were calculated by the modified equation of Ellis (1981):

ME = 1.549 + 0.0102 CP + 0.0275 oil + 0.0148 NFE - 0.0034 fibre.

ME: Metabolizable energy (MJ/Kg).

CP: Crude protein (g/Kg).

NFE: Nitrogen free extracts (g/Kg).

The experiment was carried out in the premises of poultry unit which belongs to Elnazil Company, Soba south east to Khartoum. It lasted six weeks. Minimum and maximum temperature were 10°C and 34°C, respectively. One hundred and forty four, one - day - old, unsexed commercial broiler chicks (Hypeco) were assigned into 24 pens in groups of 6 chicks in a pen. Each experimental diet was fed to 6 replicates, in a completely randomized design. Broiler chicks were kept on a deep litter floor system. Each of the germinated Fetrita was incorporated into broiler chicks' diet forming three experimental diets. The fourth diet was the control diet containing ungerminated Fetrita. Experimental diets were formulated to meet or exceed the (NRC, 1994) requirements of broiler chicks. The diets were isonitrogenous and isoenergetic. Feed and water were provided *ad ibitum*. Feed consumption, weight gain and feed conversion ratio were recorded weekly for the individual replicate of each dietary treatment. Mortality was recorded as it occurred. Routine and occasional management, vaccination and medication were carried out as and when due.

Proximate analysis of the diets was carried out according to official method of analysis of AOAC (1980). Crude protein was determined and metabolizable energy was calculated as mentioned for Fetrita. Table 1 shows calculated composition and determined analysis of experimental diets.

The data generated from the experiment was subjected to analysis of variance. Least Significant Difference (LSD) test was used to assess significance of difference between means as described by Little and Hills (1978).

Results and Discussion

Table 2 shows changes in protein content, metabolizable energy and tannin of Fetrita seeds as affected by germination process. By seventh day of germination protein content (%) of Fetrita increased by 31%. These results agreed with Wu and Wall (1980); Okoh *et al.* (1989); Elkhalifa (1993); Elmaky (1994); Hamid (2001) who reported that germination of low -

Table 3: Effects of germination of Fetrita grains for different days, when fed to broiler chicks during the starter period (0 – 21 days)

	Ungerminated Fetrita	3-days germination	5-days germination	7-days germination	SE ±	L.S.D 5%	L.S.D 1%
Number of birds	36	36	36	36			
Feed intake (g/bird)	904^{a}	901^{ab}	810^{ab}	803^{b}	33	101	148
Body weight gain (g/bird)	443^{a}	432^{ab}	383^{bc}	341^{c}	18	54.21	79.46**
Feed conversion ratio (g feed/g gain)	2.04^{a}	2.10^{a}	2.14^{a}	2.43^{b}	0.08	00.24	0.35**

^{a,b}: Row means followed by the different letter are significantly different. ** : (P< 0.01). SE: Standard error

Table 4: Effects of germination of Fetrita grains for different days, when fed to broiler chicks during the finisher period (22 - 42 days)

	Ungerminated Fetrita	3-days germination	5-days germination	7-days germination	SE ±	L.S.D 5 %	L.S.D 1%
Number of birds	35	36	36	33			
Feed intake (g/bird)	2271^{a}	2014^{ab}	1751^{b}	1888^{b}	128	382	561
Body weight gain (g/bird)	1005^{a}	1015^{a}	878^{ab}	831^{b}	57	170	249
Feed conversion ratio (g feed/g gain)	2.25^{a}	2.09^{a}	2.02^{a}	2.30^{a}	0.11	0.32	0.66

^{a,b}: Row means followed by the different letter are significantly different. **: (P<0.01). SE: Standard error.

Table 5: Effects of germination of Fetrita grains for different days, when fed to broiler chicks during the whole period (0 – 42 days)

	Ungerminated Fetrita	3-days germination	5-days germination	7-days germination	SE ±	L.S.D 5%	L.S.D 1%
Number of birds	36	36	36	36			
Feed intake (g/bird)	3175^{a}	3004^{ab}	2560^{b}	2960^{b}	151	453	656
Body weight gain (g/bird)	1447^{a}	1447^{a}	1261^{ab}	1172^{b}	67	200	293**
Feed conversion ratio (g feed/g gain)	2.18^{ab}	2.09^{ab}	2.05^{a}	2.31^{b}	0.08	0.25	0.37

^{a,b}: Row means followed by the different letter are significantly different. ** : (P<0.01). SE: Standard error

tannin sorghum increased protein content and most important protein fractions that rich in lysine (albumin - globulin fraction). Also by seventh day of germination metabolizable energy (MJ/Kg) decreased by 6%. The same results were obtained by Dalvi (1974) and Elmaky (1994). They noticed that decrease in metabolizable energy of sorghum as the result of germination process is due to the degradation of the starch to soluble sugars to meet the seedling requirements. Tannins content (as % catechin equivalent) of Fetrita increased as the days of germination increased, however after 3 days it started to decrease then increased again, but it reached toxic effect (0.68% as reported by Fuller *et al.,* 1966) only by seventh day of germination. The same findings were reported by Elkhalifa (1993); Elmaky (1994); Hamid (2001). Ahmed (1988) suggested that this increase in tannin content could be due to solubilization occurring as the grain took up water, or to synthesis of polyphenols during germination.

Tables (3, 4 and 5) show effect of different germination days of Fetrita when fed to broiler chicks during the starter, finisher and the whole period, respectively. During starter, finisher and the whole periods, body weight gain, feed consumption and feed conversion ratio of broiler chicks offered 3 - days germinated Fetrita diet were insignificantly different (P>0.05) from those offered ungerminated Fetrita diet. This agreed with the results obtained by Hamid (2001) who found better broiler performance have been observed if germination process did not exceed 3 - days. Broiler chicks fed 5 - days germinated Fetrita diet showed significant (P<0.05) poor body weight gain than those fed ungerminated Fetrita diet during starter period, although tannin content did not reach the toxic level (0.64 - 0.84 %) as suggested by Fuller *et al.* (1966). It has been reported that sprouting of sorghum reduced protein and energy utilization in rats and caused inadequate performance in growing pigs (Shem *et al.,* 1990). Hamid (2001) mentioned that germination of low - tannin sorghum for more than 3 days tends to reduce feed consumption and body weight gain.

During starter, finisher and the entire rearing periods, 7 - days germinated Fetrita diet resulted in significant (P<0.01) poor weight gain and significant (P<0.05) decrease in feed consumption. Also it resulted in significant (P<0.01) poor feed conversion ratio except during finisher period. These effects are mainly due to increase in tannin content which reached toxic level (0.64 - 0.84 %) by the seventh day of germination. Some studies reported that lysine content of sorghum grains increased as a result of germination process (Wu and Wall, 1980; Okoh *et al.*, 1989; Elkhalifa, 1993). Therefore lysine content of the diets in this study that contained germinated Fetrita was expected to increase, particularly protein content of the germinated Fetrita has increased by 31%. However, this increase in lysine was not demonstrated on the performance of broiler chicks. This is probably due to the high increase in tannin content which reached 100% by seventh day of germination. Si *et al.* (2001) reported that at starter period addition of 0.2% lysine to broiler chicks diet containing NRC (1994) recommended level of lysine resulted in insignificant

increase in body weight when compared to those fed diet supplemented with 0.1% lysine. Also they found addition of 0.3% lysine resulted in a significant reduction in body weight when compared to broiler chicks fed diet supplemented with 0.2% lysine. Furthermore, they reported that there were insignificant differences in body weight of birds fed diet supplemented with various levels of lysine at finisher period. Corzo *et al.* (2006) found that supplementation the diet of female broilers with lysine at 42 day of age had no effect on feed conversion ratio and body weight. Okoh *et al.* (1989) reported insignificant differences ($P>0.05$) between feed consumption, body weight gain and feed conversion ratio of supplemented malted sorghum with lysine and that of supplemented unmalted sorghum with lysine. All these reports may explain why increase of protein and lysine in the 7 - days germinated Fetrita diet failed to support optimum broiler performance in this diet.

Some studies have reported that tannin decreases the growth of broiler chicks. Hassan *et al.* (2003) reported that high - tannin sorghum caused a highly significant ($P< 0.05$) reduction in the weight gain and feed intake of broiler chicks compared to low - tannin sorghum and increased the feed conversion ratio ($P<0.01$). Herstad (1980); Mitaru *et al.* (1983); Barry and Manley (1984); Ibrahim *et al.* (1988) found significant decrease in feed intake of broiler chicks fed diets containing tannin. Banda-Nyirenda and Vohra (1990) and Douglas *et al.* (1991b) found poor feed efficiency when they fed high - tannin sorghum to broiler chicks. Douglas *et al.* (1990b) and Elkin *et al.* (1995) attributed this reduction in growth of broiler chicks to that tannins decrease utilization of energy, protein and specific amino acids.

It can be concluded that under the conditions of this study, germination of low - tannin sorghum increased protein and tannin contents and decreased metabolizable energy. When the germination period exceeded 3 days poor performance of broiler chicks took place.

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