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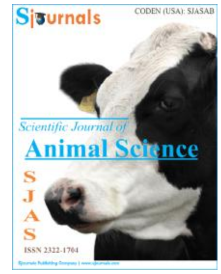

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Original article

Effect of seed processing on chemical composition and anti-nutritional contents of *Acacia saligna* seed

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An experiment was conducted to determine the chemical composition and anti-nutritional content of *Acacia saligna* seeds subjected to soaking and roasting. Each seed processing method was compared with raw seed. There was a significant (*P*<0.05) difference in dry matter (DM) content. The highest DM content was observed in roasted seeds (93.73%) followed by soaked (91.3 %) and raw seeds (90.8 %). However, there was no significant (P>0.05) difference among CP, EE, CF, NFE and ash content. Raw seeds were composed of 28.2 % CP, 15.5 % EE, 14.4 % CF, 36.8 % NFE and 5.10% ash; 28.4 % CP, 14.5 % EE, 13.3 % CF, 38.5 % NFE and 5.24% ash, and 28.3 % CP, 15.1 % EE, 15.3 % CF, 35.8 % NFE and 5.58% ash for soaked and roasted seeds, respectively. The average tannin and phytate contents were 0.525, 0.498 and 0.322 mg/g and 0.828, 0.816 and 0.132 mg/g for raw, soaked and roasted seeds, respectively. Highest reduction of tannin (38.7%) and phytate (84.1%) was observed in roasted seeds as compared to raw and soaked seeds. *A.saligna* seeds have a potential chemical composition (crude protein and energy) but have some anti-nutritional factors like tannin and phytate. Hence, seeds can be incorporated in animal feeding with proper processing methods.

1. Introduction

Acacia saligna, known as the Golden Wreath Wattle or Orange Wattle, Port Jackson willow (Midgely and Turnbull, 2003) is a dense and multi-stemmed thorn-less, spreading bushy shrub (Gutteridge, 1994;Orwa et al., 2009), or a small tree that grows 2-8 m tall (Simmons, 1988), very adaptable and fast growing tree native to Western Australia (Simmons,1988; Midgely and Turnbull, 2003). Its fruits are very narrow, 8-12 cm long and 4-6 mm wide, straight and flattened. There are 6 to 10 beanlike seeds, each 5-6 mm long x 3-2.5 mm wide, dark brown to black, shiny (Orwa et al., 2009). The adaptable nature of the tree led to its widespread distribution as important species used for soil conservation, animal fodder and source of fuel wood in different countries of the world (Midgely and Turnbull, 2003). It has been introduced into other regions of Australia, and also into many other countries (Gutteridge, 1994), including Uruguay, Mexico, Israel, Iran, Iraq, Jordan, Syria, Greece, Cyprus and North African countries (NAS, 1980).

In northern Ethiopia, especially Tigray region, *A. saligna* was introduced in the 1980s for the purpose of environmental rehabilitation, soil and water conservation to gullies, watersheds and homesteads (personal communication). The tree is the most adaptable, evergreen and easily distributed to almost all parts of the region than any other fodder plants and found widely distributed in six zones out of seven zones of the region. According to Ee and Yates (2012), whole wattle (*A. saligna*) seeds were comprised of 27.6-32.6% proteins, 30.2-36.4% carbohydrates, 12-14% fat and 13-15% crude fibre. Its palmitic, stearic, oleic and linoleic acid contents were also 9.6 %, 2 %, 20 % and 64.3 %, respectively. Besides, the anti-nutritional content of the seeds were (0.2%) phenolic, (2.2-3.4%) oxalate and (2.6-3%) saponin which were fairly high but low (0.1%) phytate content. However, it contained high level of trypsin inhibitor ranged between 2474.3-3271.4 trypsin inhibitor units per gram (TIU/g).

Wattle seeds (acacia spp.) have been used as a food sources by Australian Aboriginal people for thousand years (Maslin et al., 1998) and are highly nutritious in terms of its protein and carbohydrate contents (Yates, 2010). However, according to Ee and Yates (2012), roasting/heating of wattle seed before consumption is crucial to eliminate anti-nutritional factors like protease inhibitor, lectins, alkaloids, saponins and oxalates which interfere in the digestibility and absorption of nutrients. Similarly, roasting improves the nutritive value of *Jack beans* (Borchers and Ackerson, 1950), reduces 89.82% of trypsin inhibitor in *Cajanus cajan* (Onu and Okongwu, 2006). In addition, soaking reduces trypsin inhibitor activities in wattle seeds (Ee and Yates, 2012), tannin and cyanides (Ayenor, 1985; Marfor and Oke, 1988; Ahamefule and Odemelam, 2008) and oxalate and its toxicity (Cheeke, 1995).

In Tigray region, the value of *A. saligna* seeds as animal feed was neglected for almost two decades due to limited information on chemical composition, anti-nutritional content and its method of seed treatment. Therefore, this study was designed to determine the chemical composition and anti-nutritional content with different seed processing methods of *A. saligna* seeds.

2. Materials and methods

2.1. Study area

The study was conducted in Mekelle Agricultural Research Center, Illala site. It is located north East of Mekelle at an elevation of 2250 meters above sea level at 13^{0}28'N latitude and 39^{0}29'E longitude.

2.2. Seed collection and processing methods

A. saligna seeds were collected from Mekelle city and its surroundings in February 2013 from trees aged 3- 4 years. Three methods of seed processing (raw, soaking and roasting) were used. About 500 g sample of seeds were used for the laboratory analysis for each treatment. For soaking treatment, about 500 g of sample seeds was soaked overnight, washed with clean water, boiled for 5 minutes at boiling point of water and dried in the sun for two days. For roasting treatment, about 500 g sample seeds were also roasted at 100 ^{O}C for 3-5 minutes until the seed coats were broken.

2.3. Proximate analysis

The raw and processed seeds were grounded to pass the size of 1mm sieve. Seed samples were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash according to the methods of AOAC (2005). Phytate was determined using the method of Reddy and Love (1999) while tannin was determined using the method of Trese and Evans (1978).

2.4. Data analysis

The data were analyzed using one-way analysis of variance (ANOVA) and mean comparison among treatments was done using Least Significant Difference (LSD) at $P<0.05$. The data were analyzed using the Statistical Package for Social Sciences (SPSS) software version 16.

3. Results and discussion

The dry matter, crude protein, crude fiber and nitrogen free extract contents were 90.8%, 28.2%, 14.4%, 36.8%; 91.3%, 28.4%, 13.3, 38.5% and 93.7%, 28.3%, 15.3, 37.8% of raw, soaked and roasted *A. saligna* seeds, respectively. There was a difference among the treatments on the dry matter content of *A. saligna* seeds (Table1). Roasted seeds had the highest DM content (93.7%) than the soaked and raw seed. In the case of roasted seeds due to heat application much moisture part is removed and resulted in its high DM content. There was no variation in crude protein, ether extract, crude fiber, ash and nitrogen free extract contents among the treatments (Table 1).

The CP content of raw *A. saligna* seeds were in agreement with the findings of (28.6-32.6%) (Ee and Yates, 2012) but higher than the results of *A. colei* (22.3%) and *A. tumida* (22.6%) (Falade et al., 2005). Whereas, the CP content of *A. saligna* in comparison with other legume seeds, the raw seeds of *A. saligna* had lower CP content than raw Moringa seeds (31.1%) (Babiker, 2012), but similar to *Detarium microcarpum* seeds (26.5%) (Obun et al., 2011) and *C. cajan* seeds (27.2%) (Onu and Okongwu, 2006) while, it was higher than *F. albida* seed (20.6 %) (Hassen et al., 2007), sorrel seeds (21.0%) (Nyameh et al., 2012) and *A. africana* seeds (24.0 %) (Ayanwale et al., 2007). Similarly, the soaked *A. saligna* seeds had higher crude protein content than soaked (21.8 %), soaked and boiled (21.5 %) sorrel seeds (Nyameh et al., 2012) while the roasted *A. saligna* seed was in agreement with roasted *A. saligna* (27.8-32.1 %) (Ee and Yates, 2012) and *C. cajan* seeds (26.2 %) (Onu and Okongwu, 2006). The difference in the CP content might be attributed due to the variation in the environment, soil type and species of the plant.

The CF content of raw *A. saligna* seeds were in agreement with the findings of (12.9-14.5%) (Ee and Yates, 2012). While comparing with other seeds, it had higher CF than raw seeds of *F. albida* (6.70%) (Hassen et al., 2007), *D. microcarpum* (11.1%) (Obun et al., 2011), *C. cajan* (7.45%) (Onu and Okongwu, 2006) and *A. africana* (7.06%) (Ayanwale et al., 2007) but it was lower than the seeds of Moringa (28.5%) (Babiker, 2012) and sorrel (19.5%) (Nyameh et al., 2012). This implies that *A. saligna* seed has a thinner coat than Moringa and sorrel seeds. Similarly, the roasted seeds of *A. saligna* was in line with the findings of (12.9-13.7%) (Ee and Yates, 2012). When compared with the seeds of other legumes it had higher CF content than roasted *C. cajan* (7.19 %) (Onu and Okongwu, 2006), *A. africana* (5.20 %) (Ayanwale et al., 2007) which indicates that the seeds of *A. saligna* has a thicker coat than the other seeds listed above. Whereas, the soaked seeds of *A. saligna* had lower CF than soaked (17.5 %) and soaked and boiled (18.0 %) sorrel seeds (Nyameh et al., 2012). The difference in the CF content of the seeds may be due to the difference for the duration of soaking or roasting and type of the plant.

The EE content of raw *A. saligna* seeds were in line with the study of (12.8-13.9%) (Ee and Yates, 2012) but higher than raw *A. tumida* (7.80%) and *A. colei* (11.9%) (Falade et al., 2005). When compared with other legume seeds, it had higher EE content than *C. cajan* (1.67%) (Onu and Okongwu, 2006), sorrel (5.50%) (Nyameh et al., 2012) but lower than Moringa (28.7%) (Babiker, 2012), *A. africana* (21.0%) (Ayanwale et al., 2007). However, it was in agreement with *D. microcarpum* (15.2%) (Obun et al., 2011) and *F. albida* (13.3%) (Hassen et al., 2007). Similarly, the roasted seeds of *A. saligna* had similar results with (13.1-15.7%) EE content (Ee and Yates, 2012) but when compared with other legume seeds; it had higher EE content than roasted *C. cajan* (1.58 %) (Onu and Okongwu, 2006) while it had lower than roasted *A. africana* (24.4 %) (Ayanwale et al., 2007). The soaked seeds of *A. saligna* had higher than soaked (8.50 %), soaked and boiled (9.00 %) sorrel seeds (Nyameh et al., 2012). The difference in EE content of the seeds may be due to the difference of environmental, soil type, plant type and treatment duration.

The ash content of raw *A. saligna* seeds were higher than the findings of (3.80-4.20%) (Ee and Yates, 2012). This difference may be caused due to the difference in the environment and soil type where it grows. In comparison with other seeds, it had higher ash content than raw Moringa (3.44%) (Babiker, 2012), *F. albidda* (3.30%) (Hassen et al., 2007), *D.microcarpum*(3.49 %) (Obun et al., 2011), *A. africana* (3.22 %) (Ayanwale et al., 2007) but lower than sorrel (14.5%) (Nyameh et al., 2012). Whereas, it was in line with *C. cajan* (5.31%) (Onu and Okongwu, 2006). The roasted seeds of *A. saligna* were also higher than the findings of (4.0-4.2%) roasted (Ee and Yates, 2012). In addition to this, when compared with other seeds it had higher ash content than roasted *C. cajan* (4.40 %) (Onu and Okongwu, 2006) and *A.africana* (3.90 %) (Ayanwale et al., 2007) whereas, the soaked seeds of *A. saligna* was lower than soaked (9.00 %), soaked and boiled sorrel (10.5 %) seeds (Nyameh et al., 2012). The difference in the ash content of the seed may be due to environment, soil type and treatment length.

The nitrogen free extract of raw *A. saligna* seeds were higher than the result of (32.0-33.8 %) (Ee and Yates, 2012) whereas, when compared with other seeds it had comparable results with raw *A. africana* (34.2%) (Ayanwale et al., 2007) and lower than raw sorrel seeds (39.5%) (Nyameh et al., 2012). Similarly, the roasted seeds of *A. saligna* were not far from the result of (33.3-36.4%) (Ee and Yates, 2012) on the roasted Australian *A. saligna* seeds and it had a comparable result with roasted *A. africana* (32.0 %) seeds (Ayanwale et al., 2007). Whereas, soaked *A. saligna* seed was similar with soaked and boiled (39.9 %) but lower than soaked sorrel (42.7%) seed (Nyameh et al., 2012). Generally, the difference in the chemical composition of raw seeds may be due to environment, variety, soil type, season and other genetic factors.

Table 1

Chemical composition of raw and processed A. *saligna* seeds.

Treatment	DM (%)	CP (%)	EE (%)	CF (%)	NFE (%)	Ash (%)
Raw AS	90.8^{b}	28.2	15.5	14.4	36.8	5.10
Soaked AS	91.3^{b}	28.4	14.5	13.3	38.5	5.24
Roasted AS	93.7^{a}	28.3	15.1	15.3	35.9	5.58
SEM	0.56	0.69	0.60	0.86	1.30	0.25
Probability	0.004	0.935	0.315	0.154	0.180	0.227

Columns with different supper scripts are significantly different at $P<0.05$, AS= *Acacia saligna* seed, SEM= standard error of mean, DM= dry matter, CP= crude protein, EE= ether extract, CF= crude fiber, NFE= nitrogen free extract.

The average tannin content of raw, soaked and roasted *A. saligna* seed was 0.525, 0.498 and 0.322 mg/g, respectively, while the average phytate content was 0.828, 0.816 and 0.132 mg/g, respectively (Table 2). Roasting of seeds reduced the tannin and phytate content by 38.7% and 84.1% , respectively as compared with raw seeds.

The phytate content of raw *A. saligna* seeds was in agreement with the result of (0.10%) (Ee and Yates, 2012) but higher than *A. colei* (0.09 mg/g), *A. tumida* (0.03 mg/g) (Falade et al., 2005). When compared with other seeds, it had higher phytate content than *D. microcarpum* (0.255 mg/g) (Obun et al., 2011), *C. cajan* (0.240 mg/g) (Yisa et al., 2010) while, soaked *A. saligna* seeds were higher than boiled *C. cajan* (0.256 mg/g) (Yisa et al., 2010).

The tannin content of raw *A. saligna* seeds were lower than *A. colei* (86.7 mg/g), *A. tumida* (80.3 mg/g) (Falade et al., 2005) but when compared with other seeds, it had higher tannin content than *D. microcarpum* (0.096 mg/g) (Obun et al., 2011) and *C. cajan* (0.021 mg/g) (Yisa et al., 2010). The soaked seeds of *A. saligna* had higher tannin than boiled *C. cajan* (0.020 mg/100g) (Yisa et al., 2010). Roasting reduces the tannin content of sorrel seeds by 20%, while soaking reduces by 36% compared with raw seed (Nyameh et al., 2012), however, in the current findings roasting of *A. saligna* seed resulted higher reduction of tannin as compared to roasted sorrel seeds. Whereas, in the case of soaking methods the tannin content of sorrel seeds was considerably reduced as compared with the soaked *A. saligna* seeds of the present findings. The difference in the anti-nutritional content of different seeds may be due to difference in plant type and seed treatment methods.

Table 2

The average tannin and phytate content of raw and treated *A. saligna* seeds**.**

Treatment	Tannin (mg/g)	Phytate (mg/g)
Raw AS	0.525	0.828
Soaked AS	0.498	0.816
Roasted AS	0.322	0.132

AS= acacia saligna, mg/g= milligram per gram.

4. Conclusions

A.saligna seed is a potential source of crude protein and readily available carbohydrate incomparable to other legume seeds. However, it has anti-nutritional factors like tannin and phytate. Roasting and soaking methods have not resulted differences in the proximate chemical composition of *A. saligna* seeds. Roasting methods can considerably reduce tannin and phytate content of *A. saligna* seed. Therefore, *A. saligna* seeds with the appropriate roasting method can be used as livestock feed sources and further research is required for the anti-nutritional contents which were not discovered in this experiment like oxalate, cyanide, protease inhibitor, saponin etc.

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References

Ahamefule, F.O., Odemelam, V.U., 2008. Effect of soaking duration on the proximate composition, gross energy, mineral content and some anti-nutritional properties of Canavaliaplagiosperma seed. Proceedings of the 13^{th} Annual conference of the Animal Science Association of Nigeria (ASAN), Zaria, Nigeria, 491- 494.

AOAC (Association of Official Analytical Chemist), 2005. Official method of analysis 18^{th} edition. Association of Official Analytical Chemists. Washington D.C., USA.

Ayanwale B.A., Obun, Ayanwale, A.V., 2007. Effect of raw and roasted wild Afzelia africana seed meal based diets on broiler chicken. Int. J. Poult. Sci., 6(1), 27-30.

Ayenor, G.S., 1985. Effect of retting of cassava on product yield and cyanide detoxification. J. Food. Technol., 20, 89-96.

Babiker, M.S., 2012. Chemical composition of some non-conventional and local feed resources for poultry in Sudan. Int. J. Poult. Sci., 11(4), 283-287.

Borchers, R., Ackerson, C.W., 1950. The nutritive value of legume seeds. Effects of autoclaving and trypsin inhibitor test for 17 species. J. Nutr., 41, 339- 345.

Cheeke, P.R., 1995. Endogenous toxins and mycotoxins in forage grasses and their effect on livestock. J. Anim. Sci., 73(3), 909-918.

Ee, K., Yates, P., 2012. Nutritional and anti-nutritional evaluation of raw and processed Australian wattle (Acacia saligna) seeds. J. Food. Chem., 138(2013), 762–769.

Falade, M.S., Owoyom, O., Harwood, C.E., Adewusi, S., 2005. Chemical composition and starch hydrolysis of Acacia colei and Acacia tumida seeds. Cereal chemistry, 82(5), 479-484.

Gutteridge, R.C., 1994. Other species of multipurpose forage tree legumes. In: R.C. Gutteridge and H.M. Shelton (eds), Forage Tree Legumes in Tropical Agriculture, Wallingford, CAB International, 97-108.

Hassan, L.G., Umar, K.J., Yuguda, H., 2007. Nutritional evaluation of Faidherbia albida seeds and pulp as sources of feeds for livestock. Afr. J. Food. Agr. Nutr. Dev., 7(5).

Marfor, E.R., Oke, O.L., 1988. Phytate, FAO Corporate Document Repository. In: Introduction to Animal Science, 146-196.

Maslin, B.R., Thomson, L.A., McDonald, M.W., Hamilton-Brown, S., 1998. Edible Wattle Seeds of Southern Australia: A review of species for semi-arid regions of southern Australia(CSIRO, Forestry and Forest Products, Australian Tree Seed Centre: Canberra).

Midgley, S.J., Turnbull, J.W., 2003. Domestication and use of Australian acacias: Case studies of five important species. Aust. Syst. Botan., 16(1), 89-102.

NAS (National Academy of Sciences), 1980. Acacia saligna In: Firewood Crops; Shrubs and Tree Species for Energy Production, Washington: National Academy of Sciences, 100-101.

Nyameh, J., Ribare, A.J., Alabi, J., Mufwa, B.J., Gyau, A.M., 2012. Effect of processing on the performance and carcass yield of broilers fed differently processed sorrel seed meal (H. sabdariffa). J. Agr. Vet. Sci., 4.

Obun, C.O., Yahaya, M.S., Kibon, A., Ukin, C., 2011. Effect of dietary inclusion of raw Detarium microcarpum seed meal on the performance and carcass and organ weight of broiler chicks. Am. J. Food. Nutr., 1(3), 128-135.
Onu, P.N., Okongwu, S.N., 2006. Performance characteristics and nutrient utilization of starter broilers fed raw and processed pigeon pea (Cajanus cajan) seed meal. Int. J. Poult. Sci., 5(7), 693-697.
Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., Simons, A., 2009. Agro-fores tree Database: A tree reference and selection guide version 4.0 retrieved from (http://www.worldagroforestry.org/af/treedb/)
Reddy, M.B., Love, M., 1999. The impact of food processing on the nutritional quality of vitamins and mineral. Adv. Exper. Med. Biol., 459, 99-106.
Simmons, M.H., 1988. Acacia saligna In: Acacias of Australia, Ringwood: Viking O'Niel. (2), 180-181.
Trese, G.E., Evanse, W.C., 1978. A Text book of Pharmacog-nosy. Bailliere-Tindall, London.
Yates, P., 2010. Australian Acacias. The potential to combat child malnutrition build agricultural resilience and support adaptation to climate change in semi-arid Africa. Charles Darwin University, Western Australia.
Yisa, A.G., Edache, J.A., Oyawoye, E.O., Diarra, S.S., Yakubu, B., 2010. The effect of graded level of boiled and dried pigeon pea (Cajanus cajan) seed meal on the carcass of cockerels. J. Environ. Issu. Agr. Dev. Count., (2), 2 - 3.

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