Toxicity of *Bassia hyssopifolia* to Sheep

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Highlight: Bassia hyssopifolia, *an introduced annual, is toxic to sheep. Signs of poisoning in sheep dying from acute bassia intoxication included weakness, incoordination, tetany, and coma. The toxic principle is probably an oxalate. On the basis of oxalate content, bassia is more toxic than halogeton* (Halogeton glomeratus), *another oxalate-producing plant.* Bassia hyssopifolia *should not be further seeded or allowed to increase, and care should be taken when grazing livestock on existing stands.*

Fivehook bassia (*Bassia hyssopifolia* (Pall.) Ktze.) is an introduced annual that grows on alkaline soils and disturbed lands (Cook et al., 1956). Under optimum conditions, it produces abundant forage that is a good source of protein and phosphorus (Cook et al., 1956). Animals readily graze this plant, and in some areas it is harvested with forage crops for hay. If eaten continuously for 2 weeks or more, it may cause diarrhea.

The *bassia* genera belongs to the Chenopodiaceae family, many species of which synthesize poisonous oxalates. *Bassia* spp. in Australia contain low levels of oxalate (Everist, 1974). Bassia may also accumulate dangerous amounts of nitrate (Clarke and Clarke, 1967). It is closely related to *Halogeton glomeratus* (M. Bieb.) C. A. Mey., another poisonous introduced oxalate-producing plant of the Chenopodiaceae. The toxic effects from oxalate in forage plants on livestock have been reviewed (James, 1972).

A few cases of suspected bassia poisoning in livestock have been reported, but no experimental evidence has been presented to show that this plant is toxic (Everist, 1974). This report describes intoxication of sheep by *Bassia hyssopifolia.*

Materials and Methods

Bassia plants, excluding belowground parts, were collected in the flower stage near Ephraim, Utah, air dried, ground to a fine consistency, and stored in plastic bags at 5°C until used. This material was analyzed for ash, sodium, potassium, phosphorus, nitrogen, oxalate, and nitrate.

Varying amounts of bassia were fed by stomach tube to seven yearling white-face ewes (Table 1). The sheep were observed for signs of intoxication, and blood samples were taken at 2-hour intervals from time of feeding until shortly before death to determine toxic effects of the plant material.

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Table 1. Feeding schedule and results of feeding bassia to sheep.

Sheep	Weight (kg)	Bassia fed (g/feeding)	Oxalate fed (g)	Feeding schedule	Results
1	55	454	32.8	1 time 1 day	Died 4 hours
2	50	454	32.8	1 time 1 day	Died 4 hours
3	53	454	32.8	1 time 1 day	Died 4 hours
4	40.9	400	29.2	1 time 1 day	Died 4½ hours
5	51.4	350	25.9	1 time 1 day	Died 4½ hours
6	45.5	325→500[1]	Varied[1]	6 times over 17 days	Died 17 days
7	47.0	325→500[1]	Varied[1]	8 times over 22 days	Died 22 days

[1] Feed schedule for sheep 6 and 7:

g bassia fed	324	350	400	450	500	500	500	500
days fed (sheep 6)	1,	8,	10,	14,	16,	17		
days fed (sheep 7)	1,	8,	10,	14,	16,	17,	21,	22

The blood was analyzed for serum calcium, serum glutamic oxaloacetic transaminase (SGOT), and blood urea nitrogen (BUN).

Tissue samples were taken for histological examination from all sheep that died. The issue samples were fixed in 10% formalin and prepared for examination by standard procedures.

Results and Discussion

The results of the chemical analysis of the bassia with comparable analysis for halogeton are shown in Table 2. The soluble oxalate in halogeton is primarily sodium oxalate. Halogeton contains a higher Na-K ratio than bassia. The toxicity of the oxalate may be related to the form in which it occurs in the plant, i.e., sodium oxalate or acid potassium oxalate. This relationship has been reviewed in some detail elsewhere (James, 1972).

All seven sheep that were fed bassia died. Five died after a single feeding and two died after irregular feeding for 17 and 22 days. Signs of poisoning in those dying from acute intoxication included weakness, incoordination, coma, and tetany.

One sheep that died after the extended feeding of bassia had signs of intoxication similar to those that died more

Table 2. Results of chemical analysis of bassia and halogeton.

Plant	K %	Na %	P %	N %	Ash %	Soluble oxalate %	Nitrate
Bassia	2.73	5.00	.17	2.71	19.0	6.1	trace
Halogeton	.85	6.25	.04	1.20	25.8	12.8	[1]

[1] No determination.

acutely. However, the other sheep that was fed bassia several days had signs of photosensitization, a bloody discharge from the nose, difficulty in locomotion (hopping gate), and general body weakness. Photosensitization has also been reported to be caused by *Kochia,* an annual that is also a member of the Chenopodiaceae (Clarke and Clarke, 1967). The signs observed in bassia poisoning are somewhat similar to those found in halogeton poisoning (James, 1972). However, tetany and incoordination were more common in bassia poisoning.

The lethal dose of halogeton is considered to be about 1.06 g of oxalic acid equivalent per Kg of body weight (James, 1972); data from the current research with bassia indicate the lethal dose of oxalate in the species to be between 0.55 and 0.66 g/kg of body weight. Bassia may be more toxic than halogeton because of a difference in the chemical form of the oxalate, or there may be additional toxins present in the bassia.

Hemorrhages occurred over the surface of the rumen in the five sheep that died from acute intoxication by bassia feeding. The sheep that died after several days' feeding had enlarged kidneys but few other gross lesions. The microscopic lesions were similar to those described for halogeton poisoning (Van Kampen and James, 1969).

The serum calcium concentration of the five sheep that died from acute intoxication by bassia feeding dropped from an average of 10.9 mg per ml of serum to 3.6 mg per ml. The serum calcium concentration of one of the two sheep that died after several days' feeding dropped from a normal of 10.9 to 8.8 mg of Ca per ml of serum at time of death, whereas the serum calcium in the other sheep changed very little. The serum calcium dropped lower in two of the sheep fed a single lethal dose of bassia than would have been expected in acute halogeton poisoning. SGOT increased from 93.6 to 215 units per ml in the sheep fed lethal doses of bassia. SGOT increased from 89 to 167 units per ml in the two sheep that died after several days feeding. The increases in SGOT are not as great as would have been expected in halogeton poisoning. BUN increased from an average of 20.7 to 29.9 mg of urea nitrogen per ml of blood from feeding to deaths in the five sheep that died acutely. In the two ewes that died after several days feeding, BUN increased from 21.8 to 47.6 mg of urea nitrogen per ml of blood in one sheep and decreased from 19.1 to 17.0 in the other. The BUN did not increase as much as was expected in the two sheep that died after several days feeding.

Poisoning of sheep by bassia was in many ways comparable with poisoning by halogeton (James, 1968). Sheep poisoned by bassia had a much stronger tendency toward tetany, a slight but not marked difference in change in certain constituents in the blood, more acute intoxication, and photosensitization. The greatest difference between halogeton and bassia poisoning was survival of the animal. The two sheep fed bassia for 17 and 22 days died, whereas sheep fed halogeton would probably have adapted to the oxalate and survived. Normally, the rumen bacteria in sheep fed oxalate-producing plants or halogeton develop the ability to degrade large amounts of oxalate (James, 1967). Thus, they can eat much greater amounts than an unadapted sheep. The sheep fed bassia apparently did not adapt.

Bassia has been used as a forage species for livestock. This research indicates that bassia should not be seeded or allowed to increase and that care should be taken when livestock graze existing strands. Furthermore, *Kochia prostrata* (L.) Schrad. and similar plants belonging to the same plant family as bassia should not be used as a forage until additional research can be done on their potential toxicity. *Kochia scoparia* (L.) Schrad., a widely distributed annual, has been reported to cause photosensitization and also to accumulate nitrate (Clarke and Clarke, 1967).

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