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Ailanthus excelsa Roxb. (Simaroubaceae) Leaf: as a Potential Fodder Additive

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***Abstract*— Ailanthus excelsa Roxb. (Simaroubaceae) a promising multi-purpose tree species, as an important source of dietary nutrients, alleviate the fodder scarcity and thereby significantly boost the livestock production. The present study entailed to analyse the nutritional status of the leaf of Ailanthus excelsa Roxb. to find out its utility as food additive to ruminants. The proximate analysis revealed the presence of high moisture, total ash and acid insoluble ash contents. This plant is a good source of protein and total free amino acid was quantified high in accessions from Coimbatore, Salem, Dharmapuri, Dindigul, Theni and Trichy. Crude fat and crude fiber contents were found in substantial quantity. The anti metabolites nitrite (and most dangerous fungal toxins Aflatoxin was found in non traceable quantity, thereby the toxicity of the leaf of A.excelsa was ruled out. In view of the fact, A.excelsa leaves enriched with nutrients, especially with high protein content can be recommended as an efficient fodder for ruminants/cattle.**

***Index Terms*— Ailanthus excelsa, fodder, nutritional, antinutritional, livestock.**

I. INTRODUCTION

India has a great livestock wealth, which provides livelihood and employment to rural people. Acute shortage of available grazing to feed the livestock has forced nutritionists to look for an alternate unconventional feed resource like forest tree leaves as green fodder during lean period and in difficult environment. Tree fodders are readily accepted by livestock because they are available even during dry season and are important source of protein and other dietary nutrients. The contribution from trees and shrubs is significant, but forages rarely satisfy the mineral requirements of grazing livestock [1]. The potential of tree leaf as fodder is not preferred because nutritional values of most of the tree species are not validated. In general, it is necessary to sort out the potential of leaf fodder interms of nutritional value. Tree fodders have high levels of crude protein, minerals and high levels of digestibility. However, animals refuse to eat certain tree leaves due to the presence of particular anti-metabolites. Antinutritive factors can be a problem in some species [2] and when those species are consumed may cause problem in growth and health of the animals. Antinutritive factors present in the plants when consumed lower the digestive efficiency through a variety of mechanisms including reducing digestibility, binding of various nutrients or damaging the intestinal wall [3]. Chandran *et al.*, (2013) [4] also indicated that after appropriate treatments to remove or reduce some of the antinutritional properties present the leaf of *Ardisia solanacea*, it can be used as a food additive for livestock. Hence the present study aims to analyse the nutritive and anti-nutritive factors of *A.excelsa* to prove its suitability as a cattle food additive and an alternate fodder. Though *A. excelsa* is one of the top priority species for safety match industry in Tamilnadu, it is an excellent fodder material grows in semi-arid, semi moist region and there is a tremendous scope to develop the species as fodder tree in near future. As per the report of Bhandari and Gupta (1972) [5] the leaves are highly nutritious and palatable tree yields an average of about 500-700 kg of green leaves twice a year and also, found to be suitable fodder for cattle, sheep and goats [6]. Taking these into consideration as well as quality feed would supply all nutrients in adequate quantity.

II. MATERIALS AND METHODS

A.Collection and processing of *A. excelsa* leaf sample

The leaf samples were collected from 66 accessions of *A.excelsa* (64 from the assemblage of the genetic resources collected from different agro climatic zones of Tamil Nadu, Andhra Pradesh, Rajasthan and Uttarakhand, at Field Research station, Kurumbapatti, Salem (7 year old plantation) and 2 samples from farmer's field in Kosavapatti Dindigul; Kalligudi, Theni). The leaves were washed thoroughly with distilled water and shade dried for a week at room temperature (24 ± 2 ^{o}C) after taking fresh weight. The dried samples were powdered using an electric blender and stored in an airtight container for further analysis.

B.Nutritional and anti nutritional properties

The moisture content was determined for the fresh leaf samples by drying them at 80ºC to a constant weight. The difference between the fresh and dry weight were used for calculating the moisture content of the leaf sample. Total

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ash, crude fat (ether extract), acid insoluble ash (AIA), and crude fiber (CF), free fatty acids, Nitrite content and Aflatoxin of the leaf sample were determined following the methods described by the Association of Official Analytical Chemists [7]. Crude lipid content was determined using Soxtron apparatus. Total nitrogen (N) was measured using macro Kjeldahl apparatus and crude protein (CP) content in the sample was calculated by multiplying total nitrogen by 6.25.

III. RESULTS AND DISCUSSION

A. Nutritive factors

The result of proximate analysis revealed moisture content ranged between 24.83 % and 77.29% with an average of 51.70%. Since nutrient requirements of animal are expressed on dry matter basis moisture content is important to analyze forages as animal feed [8]. Total ash content ranged from 5.65% to 12.2% with an average of 8.1%. Lowest ash content was recorded in accession 3 of Coimbatore west zone and highest in accession 18 of Pollachi west zone. As reported [9] ash content of the tree leaves ranged between 60-150g/Kg dry matter; higher ash (>18%) and silica (13.6%) content of rice straw as compared to finger millet straw (8.4 and 5%) is the most credible reason for decreased dry matter digestibility of rice straw [10]. Ash provides no calories it only gives an indication of the total mineral content and reduces fodder quality as per the report of Pinos-Rodríguez *et al*., (2007)[11]. Dan Undersander (2007) [12] reported that 1% increase in ash content will decrease the digestible nutrients and Alfalfa containing significantly higher ash content has reduced palatability and milk production.

The acid insoluble ash a substance that has also been used to determine feed intake in cattle and the most widely used internal marker in digestibility studies [13], [14]. Among the 66 accessions maximum of 3.55% acid insoluble ash was recorded in accession 44 whereas 52 of Trichy Karur Cauvery Delta and 98 of Uttarkand found to have lowest (0.02%) acid insoluble ash content. All 66 accessions found to have the optimal quantity of acid insoluble ash recommended by BIS (4 Max) for cattle. Higher percentage of acid insoluble ash indicates the poor quality of feed [15]. The total free amino acid was quantified to be high in accessions from Coimbatore, Salem, Dharmapuri, Dindigul, Theni and Trichy. The free fatty acid content varied from 2.63% (Pollachi-21) to 7.43% (Trichy 86) with an average of 4.78 %. 32 accessions found to have free fatty acid content more than the average value.

Wide variation in crude fibre content was observed among the accessions. The crude fibre quantity differed between 11.04 % in Palani-26 and 21.82% in Pollachi -15 with an average of 14.98% which is more than the BIS standard (Max 12%). Seven accessions from Coimbatore (2), Palani, (1), Theni (3), and Trichy (1) contained optimal crude fiber content (11-12%) as recommended in BIS, indicating that these accessions are potentially palatable and better sources to feed livestock. Crude fat content ranged from 0.07% to 7.085 % with an average of 2.45% among the accessions of *A.excelsa*. CF content was recorded high in *B. hanila* (3.22%) very fast growing locally preferred fodder trees of middle hills of Nepal [16]. Crude protein content varied widely among accessions of *A. excelsa*. It ranged from 12.65 % (Pollachi-16) to 27.53 % (Trichy -87) with an average of 17.10 %. About 30 accessions found to have crude protein content more than the average value. Six accessions belongs to Coimbatore, Theni, Trichy, Dharmapuri and Kosavapatti showed protein content recommended in BIS (Min. 20 %) which were considered as good source to cattle as alternate protein. See Table I. Nag and Mathai (1994) [17] and Azim *et al*., (2002) [18] have also reported *Ailanthus* species as good sources of protein. Crude protein dietary level below 10% adversely affects rumen fermentation [19]. CP level in selected tree species like *Melia azedarach, Albizzia procera*, and *Leucaena leucoephala* was higher than 15% except *Mangifera indica* (9%) [20]**,** (29.6%) in *Emilia sonchifolia* [21], and higher level of CP was recorded in fodder tree leaves [22]. The difference in CP contents of different tree species is due to the difference in protein accumulation during growth.

B. Anti-Nutritional factors

Aflatoxins are known to be the fungal toxins that cause detrimental effects on animal and decreased feed utilization and reduced productivity. Analysis of Aflatoxin (B1, B2, G1, G2) showed not detectable quantity of aflatoxin in all the samples. Animals are highly susceptible to nitrite poisoning. When high nitrate feeds are consumed, it caused acute effect on them. The optimum level of nitrate of 0-1000 ppm in forage on dry matter basis is considered safe to feed[23], whereas if cattle consume large amounts of forage containing 1.76% or more nitrate ion found toxic [24]. In the present study, the nitrite content ranged between 3.15 to maximum of 44.64 ppm was considered as non toxic as per previous reports. Nitrite interacts with haemoglobin (20-40%), forming methemoglobin thereby reducing the ability of blood to transport oxygen and death from anoxia may occur [25]. Nitrite also involved in the formation of nitrosamines, compounds known to be carcinogenic, mutagenic, embryopathic and teratogenic in experimental animals [26]. In case of unconventional livestock feed like cassava, the cyanogenic glycosides content on hydrolysis yield a potent poison hydrogen cyanide which is the factors that limits the use of these products as livestock feeds [27], [28]. In Northern Ireland, feeding dried grass cubes containing 2.5-3.1% NO3- in DM caused cattle death within days due to clinical signs of poisoning. Grass cubes with 0.70 % nitrite in the DM produced no clinical signs whereas levels >0.7% DM can be toxic [29]. In the present investigation the nitrate level of *A.excelsa* accession was estimated less than an optimum toxic level and hence can be recommended as cattle feed.

Table -I. Nutritional and antinutritional properties of *A. excelsa* leaf on dry matter basis

S. No	Accession No	Moisture (%)	Acid Insoluble Ash (%)	Total ash (%)	Crude protein (%)	Crude Fibre (%)	Free Fatty Acids (%)	Nitrite (ppm)	Aflatoxin – (B1,B2,G1,G2)
1	1	65.42	0.90	6.45	23.55	14.93	7.1	29.55	ND*
2	2	57.45	1.05	6.05	14.41	15.69	5.23	0	ND
3	3	59.26	1.70	5.65	15.71	11.52	4.52	29.55	ND
4	89	72.03	1.70	8.75	15.73	12.11	5.78	ND	ND
5	32	45.99	1.80	9.75	15.28	16.03	4.35	0	ND
6	33	76.70	2.05	7.35	17.47	14.22	4.6	0	ND
7	5	59.93	1.15	11.15	14.39	13.35	4.32	0	ND
8	6	69.50	1.95	8.60	16.14	14.33	3.77	0	ND
9	7	24.83	1.10	5.85	14.82	15.04	6.56	0	ND
10	8	69.65	2.80	8.80	16.58	14.11	6.08	4.73	ND
11	9	63.24	1.45	7.45	17.01	16.17	4.11	0	ND
12	10	71.12	2.00	8.10	18.57	14.75	5.59	4.74	ND
13	11	68.66	1.40	9.25	16.59	15.5	3.67	17.16	ND
14	12	70.80	1.70	10.45	17.89	14.28	6.75	41.98	ND
15	200	66.96	1.15	7.30	13.95	16.91	4.48	ND	ND
16	13	60.18	1.40	8.85	20.48	14.79	6.36	0	ND
17	120	71.95	1.75	10.95	15.25	14.01	3.74	ND	ND
18	14	59.03	1.80	11.10	15.28	14.65	3.37	0	ND
19	15	32.28	2.40	11.45	16.58	21.82	3.77	0	ND
20	16	60.29	1.50	7.45	12.65	13.24	4.94	0	ND
21	17	70.12	1.40	9.45	14.41	13.97	5	11.46	ND
22	18	56.81	3.25	12.20	16.16	16.9	6.14	0	ND
23	19	54.04	1.75	7.40	18.34	13.59	3.9	19.76	ND
24	20	77.29	1.90	8.05	17.88	13.67	4.96	0	ND
25	21	69.60	1.10	8.55	16.13	16.25	2.63	0	ND
26	23	70.10	2.35	8.00	16.12	15.72	3.57	36.36	ND
27	24	55.06	2.10	8.90	16.15	14.29	4.76	0	ND
28	25	69.17	1.50	8.00	16.6	15.56	3.07	0	ND
29	26	35.08	1.70	9.20	17.47	11.04	4.87	0	ND
30	27	62.79	1.80	9.70	14.4	14.18	2.71	0	ND
31	29	68.39	1.55	7.50	14.84	16.65	3.03	3.16	ND
32	30	45.42	3.05	9.75	15.27	15.38	5.58	0	ND
33	31	57.10	1.20	7.60	17.04	20.09	3.65	11.44	ND
34	34	77.08	2.15	8.30	17.02	13.45	5.85	nil	ND
35	35	61.45	2.80	8.70	24.42	14.46	5.65	28.05	ND
36	36	69.60	1.80	7.30	17.87	14.21	3.11	0	ND
37	37	60.96	1.85	6.35	18.35	16.02	2.74	0	ND
38	38	62.43	2.60	7.10	19.19	17.02	2.81	0	ND
39	39	37.20	1.10	10.50	16.15	12.86	3.23	0	ND
40	40	66.32	0.60	5.80	15.28	14.68	3.11	0	ND
41	41	71.48	1.75	7.35	17.03	15.89	4.36	0	ND
42	46	60.66	1.00	8.35	19.65	12.6	5.55	44.49	ND

43	48	58.52	1.40	6.30	14.83	12.09	2.99	0	ND
44	54	58.72	1.90	10.70	15.28	15.98	4.64	0	ND
45	60	54.96	0.80	7.45	17.43	13.84	7.15	0	ND
46	63	39.92	1.20	9.60	14.84	14.97	5.23	0	ND
47	76	66.61	1.80	6.50	18.35	14.99	5.85	ND	ND
48	80	60.38	1.55	8.95	17.46	13.39	6.11	ND	ND
49	84	60.75	1.15	9.10	16.17	15.79	4.44	3.15	ND
50	85	76.41	2.10	9.90	16.57	14.22	6.75	ND	ND
51	86	63.00	2.10	9.65	17.46	15.83	7.43	ND	ND
52	87	75.55	0.20	7.65	27.53	14.23	7.07	19.76	ND
53	88	70.28	1.05	6.6	16.15	15.74	6.75	ND	ND
54	91	60.86	2.15	7.45	15.27	12.49	3.82	ND	ND
55	92	62.02	2.55	11.2	16.15	14.64	6.13	ND	ND
56	93	58.82	1.05	6.30	15.27	16.41	6.62	ND	ND
57	94	70.21	1.50	8.30	15.27	16.15	4.4	ND	ND
58	95	59.70	0.65	8.65	15.26	18.26	6.58	ND	ND
59	96	58.53	0.75	7.90	17.47	15.79	4.09	ND	ND
60	97	65.58	1.05	8.10	17.89	20.48	3.31	3.15	ND
61	98	75.14	0.20	8.85	18.77	17.2	5.35	ND	ND
62	102	57.93	2.55	8.75	18.31	13.64	4.81	3.16	ND
63	44	57.39	3.55	8.80	17.02	13.87	3.45	0	ND
64	47	69.97	2.15	8.85	22.27	13.95	4.32	11.44	ND
65	Kosavapatti	50.94	2.15	11.60	19.21	14.07	3.14	44.64	ND
66	Kalligudi	37.98	1.80	9.75	23.98	14.61	5.5	0	ND
	Average	51.7	1. 35	8.10	17.10	14.98	4.78		
	SE	2.39	0.08	0.29	2.10	1.84	0.59		

*ND-Not detected

IV. CONCLUSION

Livestock is an important source of livelihood of millions of landless and small land holders especially securing livelihood of economically poor communities. Vast range in chemical composition of tree leaves observed among accessions is due to different geographical distribution of plant species, climate and maturity. The proximate analysis of the leaves of *Ailanthus excelsa* provides a good source to be used as the potential nutrient for ruminants. The present investigation corroborates the view of earlier studies on nutritive factors suitable for fodder. Since *A.excelsa* leaves are a good source of crude protein, as well as an alternate protein source which may be considered as cattle feed.

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