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Research Article

Nutritional Constituents of the Plants Fumaria indica and Caesalpinia bonducella

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ABSTRACT

The nutritional constituents of the plants were determined using spectroscopic, calorimetric, flame photometric, chemical assay methods. Two lots of each plant in duplicate were evaluated for the parameters protein, fiber, fat, carbohydrate, vitamin A & C, energy value, calcium, phosphorus etc .*Fumaria indica* was found to contain protein content 10.68 -14.81 %, fiber 23.59 – 28.97 %, carbohydrate 4.93 – 6.24 % calcium 1.61 – 1.86 %, vitamin A 916.52- 1666.05 IU/g & energy 300.25 – 356.75 Kcal/100g whereas *Caesalpinia bonducella has* the protein content 18.65 - 20.32 %, fiber 12.79 – 14.07 % , fat 6.54 - 7.23 % , carbohydrate 16.91 – 18.56 % , iron 0.22 - 0.5 % , vitamin A 416.75 – 700.14 IU/g & energy 376.27 – 402.12 Kcal/100g. Further study on livestock as feed material is needed to prove their nutritional efficacies.

Keywords: *Fumaria indica, Caesalpinia bonducella*, nutritional constituents, protein, fiber.

INTRODUCTION

Plants are the oldest friends of mankind. They not only provide food and shelter but also serve humanity by preventing and curing different ailments. The medicinal plants and herbs have been used for many years in the treatment of various diseases in animals and human beings. Now-a-days, utilization of these medicinal plants is increasing. These are used in animal feed as the nutritional supplements. The interest in search for alternative/additional food and feed ingredients is of paramount importance mainly because of the global demand for grains which has exceeded the production and stiff competition between man and the livestock industry for existing food and feed material. In addition depletion of soil quality, lack of water and climate change continues to affect productivity of crop and forage plants, impacting adversely the animal productivity. With 20% of all cultivated areas, 30% of forests and 10% of grasslands presently undergoing degradation, a quarter of the world's population is sustained by production on degraded soils. A challenge therefore for animal nutrition scientists is to introduce and promote alternative feed resources that have high nutritive value and are adapted to harsh environmental conditions. There are a number of under-utilized plants adapted to local, harsh conditions available today that have tremendous potential as livestock feed. The neglect of potentially excellent animal feed resources also results in loss of plant biodiversity. The cultivation and judicious use of such plants as feed resources is expected to enhance plant biodiversity[1].

Phytochemical composition and ethnoveterinary usage of two medicinal plants i.e. *Fumaria indica* & *Caesalpinia bonducella* persuaded us to evaluate their nutritional constituent which can possibly be used as feed material for the better livestock health care.

1. Fumaria indica

English: Fumitory, Hindi: Pitpapra, Sanskrit: Parpata, Family: Fumariaceae

Fig. 1
Fumaria Indica

Botanical description – Erect or procumbent, glabrous, annual herb, 15 – 30 cm high ; stem and branches glabrous or puberulous. Leaves 1 – 2.5 cm long, multifid, glaucous with linear – acute, mucronate segments. Flowers white or pale pink with purple tips, in 2.5 – 6.0 cm long racemes. Capsule globose, upto 1.5 mm in diameter, granular – rugose, 1 – seeded.

Distribution – Distributed over greater part of India from the Himalayas, Indo- Gangetic plains down to the Nilgiri mountains as a weed of cultivation, garden and also found along road sides ascending upto 3000 mter. Distributed in Afghanista, Persi, Turkistan, Baluchistan, Pakistan, Bhutan, Nepal, Mongolia and West Asia[2].

Parts used: Whole plant.

Major chemical constituents: Protopine, cryptopine, dl-bicuculline, aldumine, fumaridine, fumarizine, spiroisoquinoline and d-hydrastine are chief alkaloids of the plant. Other, minor, alkaloids include parfumidine, parfumine, coptisine, tetrahydrocoptisine, fumariline, fumarilicine, narceimine, 8-methoxydihydrosanguinarine, oxysanguinarine, fumariflorine, lastourvilline, N-methyl corydaldine, oxycoptisine, raddeanine, N - methyl-hydrasteine, dehydrocheilanthifoline, narlumidine, papraine and paprazine, tannins, fumaric acid and other non-alkaloidal constituents such as nonacosanol, sitosterol, 19-methyloctacosanol and 3-methyloctacosanol.
The plant is considered to be diuretic, diaphoretic, anthelmintic, laxative and is used to purify blood and in liver obstruction in ethnopharmacology. Pharmacological studies show that
F. indica possesses antipyretic, antidi arrhoeal and hypoglycemic properties. It is a smooth muscles relaxant and has hydrocholeretic, by stimulating bile excretion, and hepatoprotective effects.The plant has local reputation as antidyspeptic, blood purifier, cholagogue, diaphoretic, stomachic,sedativeand tonic and is also considered useful to treat constipation, abdominal cramps, fever, jaundice, leprosy and syphilis[3].

Ethnoveterinary usage: It is a very common plant in veterinary medicine and is used to overcome constipation and urinary problems in cattle. It is used as a fodder in many parts of India, particularly in Assam. The leaf is used in udder infection of ruminants.

2. Caesalpinia bonducella
English: Bonduc nut, Hindi: Kantikaranja, Sanskrit: Latakaranja, Family: Caesalpiniaceae

Fig. 2.
Caesalpinia Bonducella

Botanical description: Large scandant or scrambling shrubs ; branches armed with recurved prickles. Leaves bipinnate, pinnae 6-11 pairs, leaflets stalked. Flowers yellow, fragrant, in axillary and terminal racemes. Pods oblong, densly armed with sharp wiry prickles, dehiscent. Seeds 1 or 2, globose or ovoid, grey.

Distribution – Throughout India, upto 1000 meter in Himalaya, in the plains on waste lands and coastal areas.

Part used- Root bark, leaf, seed

Major chemical constituents: The kernels contain 20 – 24 % fatty oil. The constituents of fatty acid composition are stearic, palmitic, oleic, linoceric, linolenic, and a mixture of unsaturated acid of low molecular weights. Seed kernels are known to contain protein. Aspartic acid, lysine, glycine, leucine, histidine, isoleucine, serine, tyrosine, glutamic acid, threonine, arginine, proline, L-alanine, methionine and phenyl alanine are the part of amino acid compostion of seeds. Other phytoconstituents such as bonducellin, caesalpin and ononitol have also been reported from seeds.

Seeds are bitter, astringent, acrid, thermogenic, anodyne, antiinflammtory, anthelmintic, antiperiodic, digestive, stomachic, liver tonic and antipyretic. They are useful in cough asthma, leprosy, skin diseases, dyspepsia, dysentery, colic, haemorrhoids, intestinal worms etc.

Ethanoveterinary usage: The seeds, leaves and roots are used for the treatment of tachycardia, bradycardia, tuberculosis, and tympanitis, pain in the abdomen, fever, cold and cough and liver fluke in ruminants[4].

The nutrient contents of the two plants i.e *Fumaria indica* & *Caesalpinia bonducella* were evaluated and are summarized in Table 1.

MATERIAL AND METHOD

Apparatus: Kjeldahl assembly was used for the estimation of proteins, UV absorbance was taken on SHIMADZU UV 1700 UV VIS spectrophotometer, sodium was evaluated on Harrison's flame photometer.

Reagents & material: Chemicals and reagents used were of analytical reagent grade. Petroleum ether, chloroform, HPLC water and ammonia solution, sodium hydroxide, potassium hydroxide & potassium thiocyanate were from RANKEM. Sulphuric acid, citric acid & hydrochloric acid were of SD fine chemicals**.** Ferrous sulphate was from HIMEDIA, potassium persulphate was from JT Baker, sodium diethyldithiocarbamte was from Sigma Aldrich. Other chemicals used were of AR grade and procured from authentic sources.

Methodology for the estimation of Fat:

Defat the sample with petroleum ether (60-80° C), Transfer the filtrate to a tared petridish portion wise and evaporate to dryness on a boiling water bath. Cool the petridish in desiccator and weigh. The extractive value is calculated as a percentage[5].

$$\text{Crude fat (\% w/w)} = \frac{\text{Weight of residue in g}}{\text{Weight of sample taken in g}} \times 100$$

Methodology for the estimation of Crude fibre:

Defat the sample with petroleum ether (60-80° C), reflux the marc sequentially in 0.255 N H_2SO_4 and 0.313 M NaOH. Washwith 1.25 % H_2SO_4, Water and ethyl alcohol. Dry and ignite the residue in silica crucible at 600 ℃ for 30 minutes .Cool the crucible in a dessicator and weigh for a constant weight and carry out the calculations[6].

$$\text{Crude fiber (\% w/w)} = \frac{(W2 - W1) - (W3 - W1)}{\text{Weight of sample taken in g}} \times 100$$

Methodology for the estimation of Protein:

Digest the sample with potassium sulphate and copper sulphate in 9:1 ratio in a digestion tube using concentrated H_2SO_4 at 400 °C for 35 minutes. Cool and add 100 ml of distilled water, transfer in a RBF and add 40% NaOH. Colour of the solution becomes blue. Add boiling chips and attach the RBF to Kjeldahl distillation apparatus, outlet of the apparatus is attached with conical flask having Boric acid solution with indicator. The distillation outlet tube is dipped in the boric acid solution. Distill the RBF mixture until the volume of conical flask containing boric becomes more than 150 ml. Titrate the distillate with 0.1N hydrochloric acid solution[7].

$$\% \text{ age of Nitrogen} = \frac{[(\text{ml}) \text{ of 0.1N HCl for sample} - (\text{ml}) \text{ of 0.1N HCl for blank}] \times 1.4007 \times \text{Normality of HCl}}{\text{Quantity of sample [in g]}}$$

$$\% \text{ age of Protein} = \text{Nitrogen content} \times 6.25$$

Methodology for the estimation of Ash:

Ignite a known amount of sample placed in silica crucible in a muffle furnace at 750 °C for 5 hours and cool. Weigh the crucible till constant weight and calculate the % age ash[8].

Methodology for the estimation of Carbohydrate:

Digest the sample with 2.5 N HCl. Develop the color using anthrone reagent and take absorbance at 630 nm using glucose as standard. Calculate the result using linear regression curve plot[9].

Methodology for the estimation of Calcium:

Digest the ash of accurately weighed sample with conc. HCL for 10 minutes and prepare the sample in HPLC grade water. Carry out the complexometric titration with EDTA using hydroxy naphthol blue indicator with color point pink to blue[10].

Methodology for the estimation of Phosphorus:

Digest the sample with sulphuric acid. Cool and add nitric acid, boil till colorless solution is obtained. Develop the color with molybdovanadate reagent and take optical densities. Calculate the result using linear regression curve plot[11].

Methodology for the estimation of Sodium:
Prepare the sample by dissolving it in HPLC grade water, filter the solution before subjecting to Flame photometer. Use analytical grade sodium chloride as standard. Calculate the result using linear regression curve plot[12].

Methodology for the estimation of Iron:
Iron in the herb is determined by converting the iron to ferric form using oxidizing agents like potassium persulphate and treating thereafter with potassium thiocyanate to form the red ferric thiocyanate which is measured cororimetrically at 480 nm[13].

Methodology for the estimation of Copper:
Copper is isolated and determined colorimetrically as copper diethyldithiocarbamate at pH 8.5 in the presence of EDTA as chelating agent. Copper reacts with sodium diethyldithiocarbamate in alkaline solution producing a yellow to brown color depending on the amount of metal present. The color is soluble in organic solvents and is extracted from the aqueous solution using carbon tetrachloride and is measured colorimetrically[13] .

Methodology for the estimation of Vitamin C:
Weigh accurately about 0.1 g of sample and dissolve in a mixture of 100 ml of freshly boiled and cooled water and 25 ml of 1 M sulphuric acid. Immediately titrate with 0.05 M iodine, using starch solution as indicator until persistent blue violet color is obtained[14].

Methodology for the estimation of Vitamin A;
Boil gently the known quantity of sample containing not less than 500 units of Vitamin A with hydroquinone, ethanol and 50% solution of potassium hydroxide, cool, add water and partition with diethyl ether. Concentrate the organic layer on rotary evaporator and dissolve the mass in 2-propanol. Measure the absorbance at about 300, 310, 325 & 334 nm. Determine the wavelength of maximum absorption[15].
Calculate the potency of sample from the expression:
A325 (1%, 1 cm) x 1830 = Vitamin A potency in units / g.

Methodology for the estimation of Calorific value by bomb calorimeter:
Weigh accurately about 1.0 g of sample pellet in silica crucible. Place a Nichrome wire across the electrodes and tie a thread touching with sample pellet. Introduce 2 ml of water and charge he bomb with oxygen gas. Place the bomb in calorimeter vessel and make all the connections. Pour the measured quantity of water into the calorimeter and start the mixer. After 10 minutes of mixing, adjust the digital temperature meter to zero. Press the ignition button. Wait till the temperature raise to a constant value, record it.

$$CV = \frac{T \times W - (CVT + CV_W)}{M}$$

Where:
CV = calorific value of sample, T = temperature rise, W = water equivalent, CV_T = calorifica value of thread, CV_W = calorific value of ignition wire

RESULT & DISCUSSION
The medicinal plants and herbs have been used for many years in the treatment of various diseases in animals and human beings. Now-a-days, utilization of these medicinal plants is increasing. These are used in animal feed as the growth promoters.
Fumaria indica & *Caesalpinia bonducella* are the plants known for their digestive, spasmolytic, diuretic, anthelmintic, hepatoprotective, antiinflammtory, antipyretic anti dysentery etc. activity. The nutritional contents of the two lots of each plant in duplicate were evaluated for the parameters protein, fiber, fat, carbohydrate, vitamin A & C, energy value, calcium, phosphorus etc (Table 1).
Fumaria indica has the protein content 10.68 -14.81 %, fiber 23.59 – 28.97 %, carbohydrate 4.93 – 6.24 % calcium 1.61 – 1.86 %, vitamin A 916.52- 1666.05 IU/g & energy 300.25 – 356.75 Kcal/100g.
Caesalpinia bonducella has the protein content 18.65 - 20.32 %, fiber 12.79 – 14.07 % , fat 6.54 - 7.23 % , carbohydrate 16.91 – 18.56 % , iron 0.22 - 0.5 % , vitamin A 416.75 – 700.14 IU/g & energy 376.27 – 402.12 Kcal/100g

CONCLUSION
Both the plants have good nutritional value in addition to the pharmacological efficacy. Further study on livestock as feed material is needed to prove their nutritional efficacies.

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TABLE 1
NUTRITIONAL CONSTITUENTS OF *FUMARIA INDICA* & *CAESALPINIA BONDUCELLA*.

CONSTITUENT	% (PERCENTAGE)	
	FUMARIA INDICA	*CAESALPINIA BONDUCELLA*
Ash	11.23 – 16.75	1.97 - 2.84
Crude fibre	23.59 – 28.97	12.79 – 14.07
Protein	10.68 – 14.81	18.65 - 20.32
Fat	0.57 – 0.92	6.54 - 7.23
Carbohydrate	4.93 – 6.24	16.91- 18.56
Food energy (Kcal/100g)	300.25 – 356.75	376.27 – 402.12
Calcium	1.61- 1.86	0.150 - 0.184
Phosphorus	0.14- 0.32	0.17 - 0.22
Sodium	0.06 – 0.07	0.07 - 0.08
Iron	0.07 - 0.13	0.22 - 0.5
Copper	0.008 – 0.009	ND
Vitamin C	0.03 - 0.065	0.016 - 0.043
Vitamin A (IU/g)	916.52- 1666.05	416.75 – 700.14

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