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Apparent metabolisable energy content of fenugreek (*Trigonella foenum-graecum* L.) seed and Galactomannan depleted fenugreek residue in roosters

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Abstract
A study was carried out to estimate the apparent metabolisable energy contents of fenugreek seed and galactomannan depleted fenugreek residue (GDFR) using roosters. The apparent metabolisable energy content in the fenugreek seed and galactomannan depleted fenugreek residue was 3125 and 3315 kcal/kg. Based on the present results, it is concluded that fenugreek seed and GDFR is a potential energy supplement for poultry.

Keywords: Fenugreek seed, GDFR, apparent metabolisable energy, roosters

Introduction
India, the spice bowl of the world with more than 50 varieties of spices being produced. The total production of spices in India is estimated at 5.8 million tonnes and it accounts for over 45 percent of the world spice trade by volume and value. Fenugreek, an important spice was produced to the tune of 1.279 lakh tones in the year 2010-11. Rajasthan accounts for 74% of the fenugreek seed produced in India [1].

Fenugreek (*Trigonella foenum-graecum* L.) is known as methi in Hindi and vendayam in Tamil. The largest producer of fenugreek in the world is India. In India, the seeds are used in curries (preparation of pickles, vegetable dishes, dhals and spice mixes such as Panch Phoron and sambar powder) and for its medicinal properties *viz*., anti-diabetic and cholesterol lowering properties [2-5], anti-hyperthyroid effects [6], against thyroxine-induced hyperglycemia [7], anti-cancer effects [8], gastro-protective effects [9], antioxidant property [10], antinociceptive property [11], antimicrobial property [12], anthelmintic property [13], anti-sterility and anti-androgenic effects [14], wound healing property [15] and also anti-inflammatory and antipyretic actions [16].

Galactomannan in fenugreek, due to its viscous property, is effective in inhibiting the intestinal glucose uptake and lower blood glucose [17], hence separation of galactomannan are undertaken at industrial levels (eg. M/s. E.I.D. Parry (India) Limited, Bio Products Division, Cuddalore, Tamil Nadu, India) to produce anti-diabetic nutraceutical. The residue is designated as Galactomannan Depleted Fenugreek Residue (GDFR) and marketed as Fenumax®. With the increased incidence of diabetes in India and the clamour for using natural drugs for diabetes, the growth of galactomannan separation from fenugreek is likely to increase resulting in more quantity of the GDFR available.

Galactomannan are the major polysaccharide found in fenugreek seed and represent approximately 50% of the seed weight [18]. The remaining 50% of the material from fenugreek galactomannan extraction industry is available as galactomannan depleted fenugreek residue (GDFR). Extractable oil from fenugreek represents about 6 - 8% of the seed weight and contains ω-3(n-3), ω-6(n-6), and ω-9 (n-9) fatty acids along with many saponins, alkaloids, and sterols [19-20]. Shahat [21] studied Egyptian fenugreek oil and reported that it consists of 33.7% linoleic, 35.1% oleic and 13.8% linolenic acids. Baccou *et al* [22] studied the fatty acid composition of fenugreek oil from different countries and found that the percentage of linoleic and linolenic acids differ according to place and conditions of cultivation of plant, and the oils had marked drying properties.

Dietary fatty acids modify the plasma lipoprotein profile and reduce the risk of cardiovascular disease, which has been shown in intervention studies [23-25] in particular for polyunsaturated

and monounsaturated fatty acids. The active therapeutic constituents of fenugreek seeds are 4-hydroxy isoleucine [26], lysine and L-tryptophan rich proteins, mucilaginous fibre (galactomannan) and other rare chemical constituents such as saponins, coumarin, fenugreekine, nicotinic acid, sapogenins, phytic acid, scopoletin and trigonelline, which are thought to account for many of its presumed therapeutic effects like, inhibition of cholesterol absorption and lowering blood sugar level [27].

Fenugreek seed and GDFR contain 24 - 26% and 26 - 32% protein, respectively. Since both the products have high carbohydrate content, the expected energy value is presumed to be equivalent to cereals. In addition, these products possess nutraceutical value.

The gross, apparent and true metabolizable energy content of fenugreek seed were 3994, 2368 and 3877 kcal/kg as per the report of Kochhar *et al*. [28], Elmnan *et al*. [29] and Mahmoud *et al*. [30] respectively. The metabolizable energy content of maize was 3309 kcal/kg [31].

In view of the above, the present work was undertaken to estimate the apparent metabolisable energy (AME) content of fenugreek seed and galactomannan depleted fenugreek residue (GDFR) in roosters.

Methodology

The fenugreek seed sample used for conducting biological trial was procured locally. The samples were ground and used for analyses.

The samples of GDFR (Parry Fenumax®) test sample used in the biological trial was received from E.I.D. Parry (India) Limited, Parry Nutraceuticals Division, Chennai, Tamil Nadu.

The biological experiment in roosters were carried out in the Department of Animal Nutrition, Veterinary College and Research Institute, Namakkal, following the standard procedures to assess the nutritive value of fenugreek seed and galactomannan depleted fenugreek residue.

Apparent metabolisable energy

The apparent metaboliszable energy content of fenugreek seed and galactomannan depleted fenugreek residue test sample was estimated in roosters (21 week-old) as per the method of Sibbald [32]. A total of sixteen roosters were randomly divided into two groups of eight birds each and housed in an individual metabolic cages. One group was fed with fenugreek seed test material and another group was fed with galactomannan depleted fenugreek residue test material *ad libitum* for three days for adaptation. Then the birds were starved for 24 h.

Each bird in the first and second group was fed with 50 g of fenugreek seed and galactomannan depleted fenugreek residue test material respectively. The excreta for 24 h period in both the groups were collected, thoroughly homogenized, weighed and dried in a hot air oven at 80^0C for 24 h and the dry matter was estimated. The calorific values of fenugreek seed and galactomannan depleted fenugreek residue as well as the excreta were assayed in an adiabatic bomb calorimeter adopting the standard procedure.

The analyzed values were used to arrive at the apparent metabolisable energy content of the fenugreek seed sample and galactomannan depleted fenugreek residue sample using the following formula:

$$AME \text{ (kcal/g air dry)} = ((Gef \times X) - Yef) / X$$

Where, Gef is the gross energy of the feeding stuff (kcal/g); Yef is the total gross energy voided in the excreta by the fed bird (kcal);

X is the weight of the feed (g).

Statistical analysis

Data collected during the investigation were subjected to statistical analysis as per Snedecor and Cochran [33].

Results and Discussion

The apparent metabolisable energy of fenugreek seed and GDFR are presented in Table 1. The gross energy content of fenugreek seed and GDFR were 4265 ± 14 kcal/kg and 4537 ± 37 kcal/kg respectively. The apparent metabolisable energy of fenugreek seed and GDFR were 3125 ± 0.02 kcal/kg and 3315 ± 0.03 kcal/kg respectively.

Table 1: Metabolisable energy (kcal/kg) content of fenugreek seed and GDFR (on DM)

Energy content	Fenugreek Seed	GDFR
Gross energy (kcal/kg)	4265 ± 14	4537 ± 37
Metabolisable energy (kcal/kg)	3125 ± 0.02	3315 ± 0.03

Each value is a mean of eight observations.

The apparent metabolisable energy of fenugreek seed observed in this study was higher than the value reported by Elmnan *et al*. [29]. The variation might be due to high nitrogen free extract and low crude fibre content in fenugreek seed samples used in this study. The apparent metabolisable energy of GDFR was higher than fenugreek seed. Galactomannan is present in fenugreek seed up to 50 per cent. Galactomannan was known to increase intestinal viscosity in poultry [34] and reduced glucose absorption [35], hence the metabolisable energy (ME) value of fenugreek seed might have been lower than GDFR. The ME value of GDFR and maize was comparable.

Conclusions

This study revealed that the gross energy content of fenugreek seed and GDFR were 4265 ± 14 kcal/kg and 4537 ± 37 kcal/kg respectively. The apparent metabolisable energy of fenugreek seed and GDFR were 3125 ± 0.02 kcal/kg and 3315 ± 0.03 kcal/kg respectively.

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