Potential Value of Acridids as High Protein Supplement for Poultry Feed

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Abstract: It is well known that acridids are an attractive and important natural source of food for many kinds of vertebrate animals, including birds, lizards, snakes, amphibians, fish and other mammals. Despite that they drew very few research attentions as feed for domesticated animals, particularly poultry, swine and freshwater fish. In the present study energy estimation and proximate analysis were conducted for four acridid species in order to determine the nutritional quality of those species and their potential value as an alternative animal protein source. The experiment revealed acridids to have a higher amount of protein content in compared to the conventional soybean and fish meals. A high amount of caloric contents were also evident in the chosen acridids. The most important conclusion of this study was that the acridids can provide a reliable and sustainable source of high quality animal protein for domesticated animals.

Key words: Nutritional potential, acridids, animal feed

Introduction
Insects in nature constitute a significant biomass, as is exemplified by the insect pests. These are mostly primary consumer and due to their high rate of reproduction tend to dominate all the sources of energy because of competitive exclusion (Ramos - Elorduy, 1997). The many benefits that insects offer us are often overlooked and underestimated. For instance, they can be used in human and animal nutrition, in medicine and also as recyclers of organic matter. Most insect species convert plant protein to insect protein very efficiently (Taylor, 1979) resulting in a high yield as compared with other breeding animals. The body tissue of edible insects may be 44-70% protein while their plant foods are only 9-10% protein (Ramos - Elorduy, 1987). According to Ueckert et al. (1972) insects are known to have high nutritional value and may be important source of protein, carbohydrate, fat, vitamin, minerals, etc. Dufour (1987) opined that protein content of ant, termites and caterpillars are higher than dried fish. Finke et al. (1985) incorporated Mormon cricket replacing Soybean meal as major source of protein in practical chick diet and found no significant difference in chick weight gain. Notably Acridids which comprises locusts and grasshoppers represent tones of edible insect protein wasted. The protein content of grasshopper varied from 52.1 to 77.1% and the quality of this protein is good and rich in several amino acids than the Food and Agricultural Organization standards (Ramos- Elorduy et al., 1982; Ramos - Elorduy, 1984). In Argelia Locusts and Schistocerca produce 9 tons of biomass per year (Gunn, 1960) and Mexico Sphenarium sp. produces more than 10 tons of biomass per year (Ramos - Elorduy, 1997). Enormous amount of toxic chemicals is used in these countries to kill them. However, insect pests are eaten by several ethnic groups (Ramos- Elorduy and Pino, 1993) and many species are preserved and stored for consumption as is the case with locusts and caterpillars of different species in Africa and with the Sphenarium grasshopper and many bugs in Mexico. In South Africa, Ledger (1987) suggested harvest of brown Locust, Locustana pardalina (Walker) as human and animal food to reduce the use of insecticides on this pest. Studies on the biology, ecology and behavior of Acridids reflect their high reproductive potential (Lomer et al., 2001) and rapid life cycle (Ananthakrishnan et al., 1985). Because of their high nutritional value and ubiquitous presence; acridids present a potential sustainable food resource in animal nutrition. A variety of insects have been shown equivalent or superior to soybean meal as a high protein source for chick growth (De Foliart et al., 1982, Finke et al., 1985; Nakagaki et al., 1987). Teotia and Miller (1974) observed no significant difference in weight gain, food consumption, or food conversion between chicks fed house fly pupae and chicks fed a fully balanced diet. (Teotia and Miller, 1973) reported no adverse effect on carcass quality and taste of the birds fed pupal diet. Studies on nutritional potential of acridids indicate that acridid tissue comprises more good quality protein than the commercially used animal protein sources in poultry feed. DeFoliart (1989) suggested development of controlled mass production of food insects indigenous to developing countries. According to DeFoliart (1992) if insects become more widely accepted as food in the industrial countries, the economic implications are obvious. Thus once suitable species are selected and appropriate breeding methods are developed, insects can provide a reliable and sustainable source of high quality animal protein.

With the view of utilizing acridids as nonconventional protein supplement in animal feed an attempt has been
Table 1: Nutritional evaluation of four acridid species

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Crude protein % ±SE</th>
<th>Crude fibre % ±SE</th>
<th>Crude lipid % ±SE</th>
<th>Carbohydrate % ±SE</th>
<th>Ash % ±SE</th>
<th>Energy (Kcal/g) ±SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>O. fuscovittata</td>
<td>63.96±0.05</td>
<td>7.51±0.16</td>
<td>6.49±0.03</td>
<td>7.51±0.32</td>
<td>5.01±0.03</td>
<td>4.65±0.04</td>
</tr>
<tr>
<td>A. exaltata</td>
<td>64.46±0.08</td>
<td>7.73±0.09</td>
<td>7.07±0.01</td>
<td>3.64±0.19</td>
<td>4.98±0.01</td>
<td>4.95±0.01</td>
</tr>
<tr>
<td>S. pr. prasiniferum</td>
<td>65.88±0.04</td>
<td>6.96±0.16</td>
<td>8.11±0.01</td>
<td>6.36±0.13</td>
<td>5.11±0.04</td>
<td>5.50±0.04</td>
</tr>
<tr>
<td>H. banian</td>
<td>63.61±0.10</td>
<td>7.16±0.13</td>
<td>7.15±0.02</td>
<td>4.81±0.24</td>
<td>4.86±0.04</td>
<td>5.66±0.02</td>
</tr>
</tbody>
</table>

Fig. 1: Mineral content (in ppm) in four acridid species.

made for nutritional evaluation of four species of acridids viz. *Oxya fuscovittata* Marschall, *Acrida exaltata* Walker, *Hieroglyphus banian* Fabricius and *Spathosternum prasiniferum prasiniferum* Walker which were well abandoned in the study area around Santiniketan. This knowledge is of immense importance as mass rearing of these nutritive acridid species following Haldar et al. (1998) method may lead to establishment of acridid farms in near future, which may serve to sustain poultry industries by supplying economic and self sustainable protein supplement in poultry diet. Moreover harvesting these food acridids from cropland and grasslands may lead to lesser utilization of harmful pesticides for their control and protect the environment from their hazardous effects. Thus these harmful insects may be utilized in a useful way as economic and self sustaining protein supplement in poultry diet especially in the developing countries like India.

**Materials and Methods**

**Sampling:** Acridids of interest i.e. *O. fuscovittata*, *A. exaltata*, *H. banian* and *S. pr. prasiniferum* were collected from nearby agricultural and grassland fields of Santiniketan (23°39’N, 87°42’E) Birbhum, West Bengal, India, by sweeping technique and reared under laboratory conditions i.e.30-35°C temperature, 70-90% relative humidity and @12D/12N photoperiod following the Haldar et al. (1998) method.

**Chemical analysis:** Acridids were freeze killed then dried in hot air oven at 40°C. Crude protein was determined by Kjeldahl method using Micro Kjeltech Apparatus.

Carbohydrate contents of four Acridid species were estimated following Anthrone method. The fresh Acridid tissue was homogenized with 0.1M phosphate buffer (pH 7) and centrifuged at 7000 rpm for 15 minutes. The supernatant was then analysed for carbohydrate content following Umbrit et al. method.

Crude lipid content was determined using Soxhlet apparatus. 2.0 gm of sample was wrapped with a Whatman filter paper (No. 1) and placed in a thimble connected with Soxhlet apparatus. The initial weight of the Soxhlet flask was recorded and filled up with 200 ml Petroleum ether (boiling point 60 - 80°C). The total apparatus was then placed over a mantle and the petroleum ether was allowed to boil for 6 - 8 hr and circulate through the thimble by Siphon process. After boiling, the flask was taken out and the Petroleum ether was allowed to evaporate. The crude lipid was determined by the difference between final weight and initial weight of the flask.

Caloric content of the Acridids was determined by Oxygen Bomb Calorimeter (Instrumentation India Co.). 1gm of dried powdered sample were transformed into pellets by a pelletizer, charged with O₂ at 300 kg/cm² of pressure within the bomb and analyzed for energy content by recording the temperature rise in °C as obtained by firing the charged bomb with sample in the Digital Oxygen Bomb Calorimeter (Instrumentation India Co.).

To determine the mineral content such as calcium, iron, zinc, magnesium, manganese in the tissue acridids, the specimen were freeze killed and dried in a hot air oven at 50°C for 48 hours. The dried samples were finely ground to powder and wet digested in aqua regia at 140°C for 3 hr. After cooling, the clear samples were diluted and metal concentration was determined by Atomic absorption Spectrophotometry (Varian Tectron AA575 series).

**Analysis of data:** Data are presented as means ±SE. One way analysis of variance (ANOVA) were carried out to compare the values between different acridid species using Microsoft excel 2000 software.

**Results and Discussion**

The results as tabulated in the Table 1, indicated that the protein content in acridids ranged from 60% to 66% of dry weight and the species wise variation in protein content was in between 1-6%. The maximum amount of protein was found in *S. pr. prasiniferum* (65.88% crude...
protein), which is a grassland species. The percentage of crude lipid ranged more or less in between 5%-8% in all the species.

The carbohydrate content of the chosen grasshopper species was found to be in between 3.6-7.5% where O. fuscovittata showed the highest and A. exaltata showed the lowest amount.

A high amount of Ca, Mg, Zn, Fe, Cu but relatively low the lowest amount.

A. exaltata

The carbohydrate content of the chosen grasshopper all the species.

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References


Anand et al.: Acridids as Alternative Animal Feed Supplement


