I. INTRODUCTION

Poultry in India, which was predominantly a backyard activity before 1960s has reached an industry status as well as an agri-business enterprise. India ranks third place in egg production and fifth place in broiler production in the world (Watt Executive Guide, 2006). At present, Indian meat production is 2.2 million tons and contributing about 260 billion (2%) to the GDP, providing both direct and indirect employment. Since the early 1990s, poultry meat has been the fastest growing sector in animal production and consumption in India. While demand has slowed for other meats, including fish, the poultry meat has accelerated and continues to lead the expansion of meat trade. Poultry meat is the cheapest animal protein providing food and nutrition security to both urban and rural population.

During the past decade, egg production increased to over 45,200 million and the per capita availability of eggs has increased to 41 eggs. Broiler meat production increased to 2.2 million tons and the per capita availability of chicken meat increased to 1.73 kg. However, it is for below the recommended consumption of 180 eggs and 10.8 kg poultry meat per person per annum as by the Nutritional Advisory Committee. Over the years, poultry meat has found broad consumer acceptance, in part due to its low relative price and less fat compared to red meat. Without any social constraint the sector is growing at 12.64 per cent per year.

The ever increase in price and non availability of maize as energy source in poultry and other livestock species forces the poultry nutritionists to search for alternate energy source. Cereals like, ragi (Eleusine corocana) and sorghum (Sorghum vulgare) which are produced in substantial quantities, particularly in certain parts of India are close to maize in proximate composition, except for variations in protein, linoleic
acid and mineral concentration (NRC, 1994). Replacement of maize with such coarse cereals reduces feed cost and also the pressure on maize requirement.

The steep increase in the cost of feed ingredients acts as a major constraint to the expansion of poultry industry, as feed alone accounts for more than 70 per cent of the recurring production cost. The annual feed requirement of the industry in India is more than 13 million tones.

Birds consume feed primarily to meet their energy requirements. Greater interest is being focused on to how best the energy can be met in different poultry rations. Carbohydrate rich sources such as yellow maize, wheat, bajra and sorghum are regarded as principal energy contributors in poultry rations. Among these, maize is an important energy source and constitutes about 50 to 60 per cent of the ration. However, the production of maize is almost static and the demand is ever increasing as an energy supplement ingredient in poultry and livestock feed formulation. Spiral hike in cost of maize, diversion of maize to starch and ethanol production, frequent contamination with mycotoxins and high moisture content in the freshly harvested lots have been the constraints in its utilization. This has stimulated researchers to search for alternate and cheaper source of ingredients having high energy value for poultry diet. Numerous studies were conducted in the past to test the feasibility of the incorporation of certain course cereals such as millets and sorghum as energy sources in poultry diets (Trinade et al., 1978; Kumar et al., 1991; Thakur and Prasad, 1992; Chavez et al., 1996; Reddy and Narahari, 1997; Rama Rao et al., 2000, 2001).

In India, finger millet (ragi) is cultivated in Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, Gujarat, Maharasthra and in the
hilly regions of Uttar Pradesh and Himachal Pradesh. Finger millet cultivation occupies a total area of 13.18 lakh hectares with a production of 16.03 lakh tons. Finger millet is the second most important food and fodder crop of the dry lands in Karnataka. It has a high level of regional or local adaptation. Although grown under dry lands, it provides an assured harvest, thus making it indispensable in specific ecosystems.

The cost of finger millet is relatively less compared to maize in the areas of its cultivation. Therefore incorporation of finger millet in place of maize can reduce the dependency on maize and also the cost of poultry feeds. The finger millet contains slightly less protein and fat and high levels of crude fibre. The metabolizable energy of finger millet reported in the literature (3024 kcal/kg) was lower than that of maize (Venkateshwara Rao, 1995). The protein is well balanced with respect to the limiting amino acids in practical poultry diets. Lysine, methionine and cystine contents in finger millet were 2.86, 2.86 and 1.51 per cent of crude protein respectively (Rachie and Peters, 1977). However, literature on utilization of finger millet in poultry diet is scanty. Sorghum and finger millet, the principal coarse grains are dry land crops most frequently grown in India and are identified as being the “new feed grains”, but their use has been limited due to human needs.

Results from poultry feeding experiments in India using ragi with maize indicate that ragi is at least equivalent to maize in protein content and quality protein efficiency ratio values and generally similar in gross energy content (3989 Vs. 4168 kcal/kg). Further, ragi is a good source of calcium (0.32%) when compared to maize (0.02%). Several chicken feeding experiments have shown that finger millet is a cheaper energy source than either maize or sorghum and can replace maize in chicken diet without altering the performance (Thakur et al., 1985).
Sorghum is one of the important food crop of Rajasthan, Maharashtra, Andhra Pradesh, Madya Pradesh, Uttar Pradesh, Gujarat, Karnataka, and Tamil Nadu. This cereal is grown on 47 million hectares with a production rate of 400 kg/ha. Sorghum and millets grossly resemble in proximate composition except for variations in protein, linoleic acid and mineral concentration (NRC, 1994). Replacement of maize with sorghum reduces the feed cost and also the pressure on maize supplies. Several attempts have been made to study the possible inclusions of coarse cereals in poultry diets replacing maize (Purushotham and Thirumalai, 1995; Dixit and Baghel, 1997; Pour Reza and Edriss, 1997; Rama Rao et al., 1998). However, information available on the consequences of replacement of maize with coarse cereals on isocaloric basis is limited and inconclusive (Attia and Rahman, 1996). Sorghum as an energy source is almost similar to maize and contributes protein up to 12 per cent. Amino acid composition is more or less similar to maize, but its use as animal feed is limited due to human needs and due to presence of anti-nutritional factors like tannin. Several new sorghum varieties with high nutritive value and low tannin content (White variety) have been developed by scientists in recent years to meet its growing demand by human population (NRCS, 1999). The results of several chicken feeding experiments show that low tannin variety of sorghum can replace maize without altering growth performance (Rama Rao et al., 2002; Raju et al., 2003).

The supplementation of broiler diets with small quantities of fat and oils is a long standing practice for improving the consumption and palatability of mash, increasing the energy density in cereals having low metabolizable energy values and stimulating the growth. Although, it is established that addition of fat or oil will have an important effect upon growth rate, only few
studies have been carried out on the inclusion of oil in finger millet and sorghum based poultry diets.

Ragi and sorghum have high content of non-starch polysaccharides which adversely affect performance of birds. Many studies have reported that Xylanase supplementation to wheat based poultry diets alleviate the anti-nutritional activity of NSPs and improve performance of broilers. However, studies using enzymes and oils to enhance the nutritive value of ragi and sorghum are scanty. Further, the effect of millets on carcass quality and yield is also required to be explored.

Keeping the above facts in view, the present study was conducted with the following objectives.

1) To compare the chemical composition of finger millet, sorghum and maize.

2) To determine the metabolizable energy (ME) of ragi and sorghum by bio-assay vis-à-vis in the presence of soyoil and fish oil in experimental diets fed to broilers and developing regression equations to predict ME.

3) To study the effect of feeding finger millet and sorghum on growth performance, feed efficiency, survivability and carcass characteristics in broilers.

4) To study the effect of ragi and sorghum along with soyoil and fish oil in broiler diets on growth performance and associated changes in serum lipid profile.

5) To observe the influence of NSP degrading enzymes on the nutritive value of ragi and sorghum at 50 and 25 per cent each and in combination replacement of maize.