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Review Article

REPLACEMENT OF MAIZE WITH PEARL MILLET IN BROILER CHICKEN DIET-A REVIEW

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Abstract: Maize is the major feed ingredient in broiler diet with the inclusion level of around 60 per cent in the total diet. In India, with marginal increase in maize production coupled with poor production per hectare, the gap between the supply and demand is going to widen and this may put lots of pressure on the price of maize at most of the year. While maize is largely diverted for starch and ethanol production, it becomes essential to identify and evaluate less expensive, readily and locally available energy source for poultry feeding in the place of maize. The nutritionists and feed manufacturers are vying for alternative grains for partial or full replacement of maize. Pearl millet is one of the most drought-tolerant of all domesticated cereals. It can be grown under seasonal rainfall as low as 200–250 mm (Bidinger and Hash, 2003) making it the only reliable productive cereal in the driest rain-fed regions of the arid and semi-arid tropics. Hence literature on feeding value of pearl millet for broiler was reviewed.
Keywords: Pearl millet, Maize, Replacement, Feeding value, Broiler, Performance.

Introduction

Body Weight gain and Feed intake

Literature started appearing as early as 1976, to study the effect of partial or complete replacement of maize with pearl millet in broilers as well as layers. Using cockerels, Singh and Barsaul (1976) replaced maize completely by pearl millet to study the growth production from 8 to 14 weeks of age and reported slightly better body weight than maize fed group, though not significant.

Sharma *et al*. (1979) observed a weight of 580 g per bird in broiler chicks, fed rations with lower rate of pearl millet inclusion (36.80 per cent) that was significantly higher ($P<0.05$) than the one fed with wheat (537 g per bird) and sorghum (512 g per bird). In groups fed with cereals at high inclusion rate (55.20 per cent), pearl millet group recorded maximum body

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weight of 548 g per bird than any other cereal fed group. There was no significant effect of cereal source or inclusion rate on feed intake.

In an experiment with broilers to study the effect of pearl millet inclusion replacing maize up to 4 weeks from 1st week of age with isocaloric and isonitrogenous diet, Sinha *et al*. (1980) registered a marginally higher weight gain of 390 g per bird in pearl millet group compared to 383 g per bird in maize group. The feed intake in the pearl millet group was 815 g whereas it was 899 g in maize fed group.

Broilers fed with pearl millet replacing 37.50 per cent of maize for 8 weeks significantly ($P<0.05$) gained a body weight of 1356 g, than maize (1185 g) fed group (Asha Rajini *et al*., 1986). But the feed consumption was higher (3.16 kg) in pearl millet fed group than in maize fed group (2.91 kg).

While attempting use of ground pearl millet in broilers replacing maize in isocaloric and isonitrogenous diet, Satyanarayana Reddy *et al*. (1991) found that both 50 and 100 per cent replacement groups could not exert any significant influence on body weight and feed intake but, birds with 50 per cent ground and unground pearl millet recorded better body weights (1946.50 and 1963.40 g) than 100 (1881.70 and 1850.44 g) 0 (1824.20 g) per cent. The higher weight gain at 50 per cent groups was directly due to higher feed intake.

Thakur and Prasad (1992) reported that the body weight gain in broilers was highest ($P<0.05$) with 100 per cent pearl millet followed by other wheat combinations. Feed intake followed the same trend.

Rama Rao *et al*. (2002) observed that weight gain of broilers were significantly lower at 3 weeks (217.10 vs 255.20 g) and 5 weeks (748.20 vs 833.40 g) of age but not at 7 weeks (1394.40 vs 1478.00 g) of age when maize was replaced totally by pearl millet.

Elangovan *et al*. (2003) conducted an experiment to assess meat production potentiality and economics of broilers raised on pearl millet based diet with and without mixed enzyme preparation. Enzyme supplementation improved body weight marginally in birds fed diets having 14, 32 and 51 per cent pearl millet replacing 25, 50 and 75 per cent of maize, respectively.

The feeding value of sorghum, pearl millet and ragi compared with maize was evaluated in commercial broilers (Raju *et al.*, 2003). The body weight was significantly ($P<0.01$) higher in the groups fed sorghum and pearl millet than in maize fed group.

In contrast, the body weight gain was significantly ($P<0.01$) depressed by replacing yellow maize with pearl millet at all the levels of inclusion in the diet at 21 days of age of broilers

but at 42 days of age, growth depression was observed at and above 50 per cent level (Rama Rao *et al*., 2003).

Rama Rao *et al*. (2004) reported that replacement of maize with pearl millet on weight basis did not influence the body weight gain 21 and 35 days of age. But replacing yellow maize with pearl millet on nutrient basis, the weight gain increased progressively and significantly ($P < 0.01$) with increase in level of pearl millet in the diet.

Feed efficiency

Sharma *et al*. (1979) reported that millet included in broiler diet at lower (35.50 per cent) and higher rate (55.20 per cent) resulted in best feed conversion rate of 2.49 and 2.35, respectively than sorghum, wheat and maize fed groups.

Better feed efficiency (2.09) was obtained with the pearl millet included diet followed by maize (2.35), rice polish (2.56), sorghum (3.05) and wheat (3.29) in broilers (Sinha *et al.*, 1980).

While replacing maize with other grains in broiler diet, the feed efficiency of pearl millet fed group was better with 2.40 (Asha Rajini *et al*., 1986).

Satyanarayana Reddy *et al*. (1989) reported similar feed per gain values in pearl millet and maize fed broilers. Substitution with pearl millet whether ground or unground, in place of maize, could not exert any significant influence on feed efficiency (Satyanarayana Reddy *et al.*, 1991).

In a study where maize was replaced at 50, 75 and 100 per cent by pearl millet, wheat and rice polish in broilers (Thakur and Prasad, 1992), only pearl millet group showed no significant deviation in feed efficiency from maize group when others showed significantly ($P<0.05$) poorer difference.

Rama Rao *et al*. (2002), in their detailed study on various cereal usage in place of maize in broilers, found that maize was superior in feed efficiency at the end of 3 and 5 weeks of age but observed no significant change in feed efficiency between maize (2.87) and other groups fed with pearl millet (2.77), finger millet (3.04) and sorghum (2.93).

Pearl millet (1.89) and sorghum (1.89) showed significantly ($P<0.01$) better feed conversion efficiency over maize (2.49) and ragi (2.49) in an experiment in broilers fed from 2 – 6 weeks of age (Raju *et al.*, 2003).

In a trial with broilers fed with pearl millet at graded levels of replacing maize (25, 50, 75 and 100 per cent), Rama Rao *et al*. (2003) found no significant difference in feed conversion efficiency in any group at the end of 42 days of trial, though numerically lower feed

conversion efficiency was observed in pearl millet fed groups than maize fed group at the end of 21 day trial.

The use of whole pearl millet in broiler diet (1-15 days of age) exerted no significant difference in feed conversion between maize and pearl millet fed groups (Hidalgo *et al*., 2004).

Rama Rao *et al*. (2004) reported that the feed efficiency improved when replacing maize on nutrient basis but not on weight basis. However, there was no statistical difference between feed efficiency in pearl millet group and maize fed group.

Digestibility and metabolizability of nutrients

Singh and Barsaul (1976) found the digestibility coefficient and balance of nutrients were positive in diets with pearl millet replacing maize at 40 per cent level at the end of 9^{th} week of broiler trial. However, they found the digestibility of nutrients at the end of third week of age to be lower.

Raju *et al.* (2003) reported better metabolizablity of dry matter, crude fibre and crude fat in sorghum and pearl millet fed broilers at two energy levels of 2500 and 2750 kcal/kg. Crude protein metabolizablity was highest with pearl millet (62.88 per cent) followed by sorghum (55.03 per cent). Crude fibre metabolizablity was similar in high energy group whereas at low level of energy, sorghum and pearl millet showed higher crude fibre metabolizability than others. Calcium retention was highest in sorghum fed group followed by pearl millet group and was the lowest in ragi fed group. Phosphorus retention was highest in pearl millet fed group followed by ground ragi and sorghum groups.

In a trial with broilers fed with whole pearl millet at different levels (0, 5, 10, 15 or 20 per cent), Hidalgo *et al*. (2004) found no statistical difference in the digestibility values among the groups.

Singh *et al.* (2004) reported that protein digestibility in three new pearl millet hybrids was 74, 78 and 80 per cent compared to sorghum (76 per cent). The digestibility of amino acids in pearl millet hybrids was similar to sorghum (>70) in broiler diets.

Blood parameters

Haemoglobin and Packed cell volume

The normal blood haemoglobin level in broilers was 7 – 13 g/dl and packed cell volume was 24 – 45 per cent (Banerjee, 1998).

Triglycerides and Cholesterol

Rama Rao *et al.* (2003) reported reduction in serum cholesterol in birds fed pearl millet at all levels at the end of 42 day trial in broilers. The reduction was significant ($P<0.05$) at inclusion levels of 25 (113 mg/dl), 50 (115 mg/dl) and 75 per cent (110 mg/dl). Serum triglycerides concentration was significantly higher in 50 per cent pearl millet diet only. At the end of 42 days of trial, HDL cholesterol (44.30 mg/dl) was found to be statistically decreased ($P<0.01$) in totally replaced pearl millet diet.

Rama Rao *et al.* (2003) reported that the concentration of triglycerides and HDL cholesterol were not altered due to total replacement of maize with pearl millet at 21 days of age of broilers. However, at 42 days of age, the serum HDL cholesterol concentration significantly decreased ($P<0.01$) when pearl millet was used as the sole source of energy.

Concentration of total cholesterol and LDL cholesterol in blood serum of broilers were found to decrease significantly as the level of pearl millet was higher (75 or 100 per cent on weight by weight basis and 50 per cent on nutrient basis) compared to maize fed group (Rama Rao *et al.,* 2004). They observed the serum triglyceride concentration to be higher in isonutrient based pearl millet diet fed birds compared to those containing pearl millet on weight basis.

Slaughter studies

The investigations on the effect of feeding pearl millet on slaughter studies in broilers are few. Rama Rao *et al*. (2002) found significantly higher intestinal and abdominal fat weight, but no increase in intestine and gizzard weight which they attributed probably a higher energy value of pearl millet for the higher abdominal fat though the feed intake was not higher.

Later, in an isocaloric and isonitrogenous diet containing pearl millet replacing maize completely at 2500 and 2750 kcal/kg of ME, Raju *et al.* (2003) found highest abdominal fat pad weight at both levels of energy. Dressing loss, eviscerated weight, weight of liver and gizzard were statistically comparable to maize fed group.

Rama Rao *et al*. (2003), in their experiment in broilers fed with pearl millet at graded levels replacing maize did not find any statistical difference in the weights of giblets, gizzard, liver and abdominal fat.

Increase in abdominal fat was found in birds fed with pearl millet replacing maize on nutrient basis but not on weight basis (Rama Rao *et al.*, 2004). While relative weight of gizzard was similar in maize and pearl millet fed birds on weight basis, it decreased at 100 per cent pearl millet used diets on either basis.

Hidalgo *et al.* (2004) confirmed significant increase in the fat pad as a percentage of live weight for the broilers fed diet containing 10 per cent whole millet.

Raju *et al.* (2004) reported no difference in ready - to - cook yield, weight of gizzard and giblets, length of small intestine, caeca and large intestine among the treatment groups in weight by weight replacement of maize with pearl millet with or without enzyme supplementation (1 kg/tonne of feed).

Cost effectiveness

Rama Rao *et al.* (2002) reported that cost (Rs) of feed required to produce one kg of live weight gain in maize fed group was 18.22, whereas in pearl millet, finger millet and sorghum fed groups, it was 15.52, 18.19 and 17.27, respectively. It was Rs. 2.70 less by replacing the maize with pearl millet.

Feed cost per unit gain and meat yield were significantly ($P<0.05$) less in all pearl millet-soya based diet. The feed cost per unit meat yield was less in diets with 51 per cent pearl millet replacing 75 per cent maize and also supplementation of enzyme reduced the cost of feed per unit gain marginally (Elangovan *et al.,* 2003).

Recommended Level of replacement

Satyanarayana reddy *et al*. (1991) concluded that bajra can replace maize completely without adversely affecting the broiler performance. It is in agreement with those of Asha Rajini *et al*. (1986) and Abate and Gomez (1984).

Rama rao *et al*. (2004) recommended that maize can be replaced in *toto* with pearl millet on weight basis without affecting growth, feed efficiency, carcass traits and immunity in broilers. Similarly, Raju *et al*. (2004) concluded that bajra and jowar could replace maize on part by part basis.

Jha nisha and Kumar naresh. (2008) suggested that maize can be replaced by pearl millet up to 100 per cent level in broiler ration without affecting their performance.

Bulus *et al.* (2014) concluded that, complete replacement of maize with pearl millet, finger millets or with yellow guinea corn in broilers diet did not impair feed intake, body weight, feed conversion ratio and nutrient retention.

Based on the review maize could be replaced successfully with pearl millet in broiler chicken diets.

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