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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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# Egg Quality Traits of Layers Influenced by Supplementation of Different Levels of Sugarcane Press Residue

N. Suma[1], B.S. Venkatarami Reddy[1], R.G. Glori Doss[1], Rajeswara Rao[2], K. Chandrapal Singh[1], M.T. Rekha[3] and Amitha R. Gomes[4]
[1]Department of Animal Nutrition, Veterinary College, KVA FSU, Bangalore-24, Karnataka, India
[2]CPDO, Hesaraghatta, Bangalore, Karnataka, India
[3]Department of Veterinary Pathology, Veterinary College, Anand, Gujarat, India
[4]IAH & VB, Hebbal, Bangalore-24, India

**Abstract:** Nearly three percent of the crushed sugarcane from sugar industries turns into Sugarcane Press Residue (SPR), which is a valuable source of minerals as well as organic matter. A biological experiment was conducted using 160 (32-week old) white leg horn hens to assess the beneficial effect of Sugarcane Press Residue (SPR) in soya and fish based diets. Two BIS (1992) specified practical control diets for both soya ($T_1$) and fish based ($T_5$) test diets were formulated, while the SPR was included at three levels (5%, 10% and 15%) in test diets of both soya based ($T_2$ to $T_4$) and fish based ($T_6$ to $T_8$) types to form a total of eight treatment diets. Each of such formulated diets was offered to five replicates of four birds each reared in colony cages for a period of twelve weeks. Among the egg characteristics studied, the 84 day mean egg weights were found to be 54.70, 53.58, 52.46, 54.69, 54.09, 54.22, 53.21 and 52.62 g in $T_1$ through $T_8$ groups, respectively. Inclusion of SPR inconsistently ($p>0.05$) reduced the egg weights when compared to control groups both in soya and fish based diets. Average egg shape index values ranged from 76.30 ($T_1$) to 78.16 ($T_7$). Mean albumen index values were comparable. Mean Haugh unit score values ranged ($p>0.05$) from 52.17 ($T_1$) to 56.49 ($T_8$). From the different egg parameters studied, it can be concluded that SPR appears to be a valuable source of organic as well as inorganic nutrients for economical layer production.

**Key words:** Layers, sugarcane press residue, egg weights, egg shape index, haugh unit score, yolk index

## Introduction

Poultry industry of India has been transformed into a vibrant industry from just that of a backyard activity, while contributing nearly about 1.25 percent to the National GDP with a value of Rs. 12,500 crores. With an annual production of 40 billion eggs, India occupies the fourth position in global map of egg production that plays a great role in rural and urban socio-economic fabric as well. Marginal deficiencies of both major and minor mineral elements invariably cause significant reduction in the birds' performance (Scott *et al.*, 1986). There is, therefore, both a need and scope for improvement in the mineral nutrition of poultry through it's sourcing as well as enhancing its availability.

Sugarcane Press Residue (SPR) also called as Pressmud or Filter cake is a soft, spongy, amorphous and dark brown to brownish white material produced during process of precipitation of cane juice. The mineral composition has shown that the SPR is a potential source of major minerals (Ca-2.40%, P-1.27%, K-1.81%, Mg-1.28%, S-2.62%) as well as of trace elements (Cu-22.6ppm, Fe-2042.0ppm, Zn-36.5ppm, Mn-228.0ppm) (Reddy, 2002).

Suresh (2004) while provisioning sugarcane pressmud at one, two and three percent inclusion in diets of three to three-and-a-half months' age ram lambs, concluded that SPR as a source of organic as well as inorganic nutrients can be a wholesome substitute, to spare the costly and scarce conventional feed ingredients for economical sheep production. Budeppa (2004) fed commercial broilers with diets containing four levels of sugarcane pressmud vis-à-vis in both fish based and soya based diets. During the 42-day experimental period, he concluded that the sugarcane pressmud appears to be a valuable nonconventional feedstuff for broilers.

Thus, a study of SPR with possibility of inclusion up to 15 percent was being taken up to assess the effect of different levels on egg quality traits of layers fed either soya based or fish based diets.

## Materials and Methods

### Sugarcane press residue

**Collection and storage of SPR:** Sugarcane Press Residue also known as pressmud/filter residue is obtained after the sugarcane juice being boiled and filtered to remove the accompanying mud and other organic particles before the juice is subjected for sugar extraction in sugar industry. The SPR samples were collected from different factories of Karnataka for initial screening and sufficient amount was procured from Mysore paper mills, Shimoga for experimental purpose.

The procured SPR samples were dried under sun till they became air dry and were stored for further evaluation.

**Screening of SPR samples:** The sugar cane press residue samples were first screened for proximate composition (AOAC, 1995) and then for microbiological as well as for multimycotoxin estimation. Further, the SPR samples were subjected to calcium and phosphorus analysis.

**Experimental design**

**Formulation of experimental diets:** The conventional practical control layer diets (soya-based and fish-based) involving shell grits, calcite powder, di-calcium phosphate and salts of pertinent trace minerals were formulated as per Bureau of India Standards (BIS, 1992) specifications. In the test diets, the SPR, an unconventional source of minerals, was included at three different levels (5, 10 and 15 percent) vis-à-vis in combination with two different protein sources i.e., in soya-based and fish-based diets at the expense of relevant mineral contributing salts as described in Table 1.

**Randomization and experimental care:** A total of one sixty BV-300 commercial layers of about 32 weeks age were selected. Birds were housed in two twin-bird colony cages each measuring 15''×15''×18" size to serve as a replication. All birds were divided randomly into 40 groups of 4 birds each. Each of the 8 diets described earlier were offered to five such replications of 4 birds each in colony cage units. A completely randomized design was employed to carryout the experiment. The birds were maintained under standard managemental conditions. The experiment lasted for 84 days that was conveniently divided into three 28-day interval periods.

**Egg characteristics**

**Egg weight:** The eggs produced under each replicate group were weighed on two occasions of every week of the experimental period. The weights so obtained on eight occasions during a particular 28-day (four-week) period were averaged and the data were arranged as per treatments.

**Egg shape index:** Shape index was calculated from eggs produced in different groups at every 28-day interval. The measurements were obtained by using Vernier Calipers as described by Gulati and Nangia (1973).

$$\text{ESI} = \frac{\text{Horizontal diameter (breadth)}}{\text{Vertical diameter (length)}} \times 100$$

Table 1: Description of sugarcane press residue-based experimental diets for layers

| Treatment no. | Treatment description |
|---|---|
| $T_1$ | Control diet for soya-based test diets |
| $T_2$ | 5%SPR inclusion in soya-based diet |
| $T_3$ | 10%SPR inclusion in soya-based diet |
| $T_4$ | 15%SPR inclusion in soya-based diet |
| $T_5$ | Control diet for fish-based test diets |
| $T_6$ | 5%SPR inclusion in fish-based diet |
| $T_7$ | 10%SPR inclusion in fish-based diet |
| $T_8$ | 15%SPR inclusion in fish-based diet |

**Albumen index:** Albumen index was calculated for all eggs produced in different replicate groups at every 28 day interval. Each egg was broke open and the entire contents were carefully placed on a glass slab, then the albumen height was measured using Ames Haugh Unit Spherometer and diameter by Vernier Caliper. The Albumen Index (AI) was calculated as:

$$\text{AI} = \frac{\text{Albumen height}}{\text{Albumen diameter}} \times 100$$

**Haugh unit score:** Every 28-day once, the eggs were collected in each group and were weighed individually. Each egg was broken and the entire contents were carefully placed on a glass slab, then the height of albumin was recorded at two places (one near to yolk and the other at the end of dense albumen) by using Ames Haugh unit meter. Following this, the relationship between egg weight (g) and albumen height (mm) for each egg was calculated as haugh unit score. The values were then arranged according to treatments under each 28-day period.

**Statistical analysis:** Data pertaining to various egg quality parameters obtained during the experimental trial were analyzed in Completely Randomized Design according to the methods described by Snedecor and Cochran (1980).

## Results and Discussion

**Laboratory analysis of sugarcane press residue and experimental diets:** Composition of SPR on DM basis (Table 2) revealed that it resembles several cereal grains on the basis of crude protein of 12.67 percent; a value similar to that reported by Singh and Solomon (1995) although the ether extract, crude fibre and total ash values of 7.50, 17.50 and 24.62 percent, respectively were quite high.

The mineral profile of SPR revealed that it is a good source of both major as well as minor minerals especially of Calcium (4.52%), Phosphorus (1.25%), Potassium (1.81%), Sulphur (2.62%), Iron (2042 ppm) and Manganese (228 ppm). These values are well within the range as reported by Singh and Solomon

Table 2: Proximate composition and mineral profile of SPR

| Sl. No. | Parameter | Level |
|---|---|---|
| | Proximate composition | |
| 1 | Dry matte r(%) | 90.77 |
| 2 | Crude Protein (%) | 12.67 |
| 3 | Ether Extract (%) | 7.50 |
| 4 | Crude Fiber (%) | 17.50 |
| 5 | Total ash (%) | 24.62 |
| 6 | NFE (%) | 37.71 |
| 7 | AIA (%) | 9.51 |
| | Mineral profile | |
| 8 | Phosphorus (%) | 1.25 |
| 9 | Potassium (%) | 1.81 |
| 10 | Calcium (%) | 4.52 |
| 11 | Magnesium (%) | 1.28 |
| 12 | Sulphur (%) | 2.62 |
| 13 | Iron (ppm) | 2042.00 |
| 14 | Manganese (ppm) | 228.00 |
| 15 | Zinc (ppm) | 36.5 |
| 16 | Copper (ppm) | 22.6 |
| 17 | Cobalt (ppm) | 236.7 |
| | Other parameters | |
| 18 | pH | 6.35 |
| 19 | Organic carbon (%) | 40.87 |

(1995); however, slightly different than the composition reported by Suresh (2004) and Budeppa (2004). The variability in composition may be due to quality of the cane crushed and the process followed for clarification of cane juice in the sugar industry. When SPR included in the poultry diets, it would spare the expensive mineral sources particularly that of dicalcium phosphate or bone meal and certain trace mineral salts that are mandatorily included in the compounded poultry feeds.

The SPR samples after having been subjected to screening for proximate composition and various minerals have also been subjected to screening for microbial contamination which has revealed that they were negative for *E. coli*, *Bacillus* and *Salmonella* species in samples collected from different sugar factories. Further, the sample under study did not carry any mycotoxin with it as it is an usual trend to come across with mycotoxin contamination during harvesting and processing of many feed ingredients in that the fresh SPR carries high moisture and is vulnerable for fermentation (fungal).

The proximate composition including that of calcium and phosphorus of experimental layer diets compounded on different occasions of the 84-day experimental period is given in Table 3. The results revealed that the proximate analysis of layer diets was similar among all the 8 diets. As expected, the contents of crude protein and NFE in layer diets tended to decline with incremental levels of SPR in such diets. Such a trend was quite opposite for rest of the nutrients especially for ether extract and crude fiber.

## Egg characteristics

**Egg weight:** The influence of different treatments on the average egg weight under different dietary groups is presented in Table 4.

Table 3: Proximate composition of experimental layer diets (% on DM basis)* *Average values of compounded diets on six occasions

| Treat-ments | DM | CP | EE | CF | TA | NFE | Ca | P |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 89.90 | 17.57 | 1.91 | 7.15 | 13.09 | 60.28 | 3.92 | 0.80 |
| $T_2$ | 89.85 | 17.36 | 2.36 | 7.20 | 13.25 | 59.83 | 3.93 | 0.76 |
| $T_3$ | 89.85 | 17.20 | 2.91 | 7.36 | 14.46 | 58.07 | 3.93 | 0.72 |
| $T_4$ | 89.37 | 17.01 | 3.39 | 7.42 | 14.36 | 57.82 | 3.93 | 0.68 |
| $T_5$ | 89.56 | 17.48 | 2.26 | 7.19 | 15.17 | 57.91 | 3.92 | 0.81 |
| $T_6$ | 89.37 | 17.39 | 2.74 | 7.36 | 15.37 | 57.15 | 3.93 | 0.77 |
| $T_7$ | 89.35 | 17.23 | 3.30 | 7.50 | 15.26 | 56.71 | 3.93 | 0.73 |
| $T_8$ | 89.26 | 17.09 | 3.83 | 7.60 | 15.81 | 55.67 | 3.93 | 0.69 |

Table 4: Average periodic[1] weights (g) of eggs of experimental birds fed different diets

| Treat-ments | Average egg weights (g)$^{NS}$ | | | |
|---|---|---|---|---|
| | Period I[1] | Period II[1] | Period III[1] | Cumulative |
| $T_1$ | 54.35±0.69 | 54.11±0.44 | 55.65±0.22 | 54.70±0.43 |
| $T_2$ | 52.92±0.88 | 54.03±1.09 | 53.78±0.81 | 53.58±0.85 |
| $T_3$ | 52.29±0.86 | 51.75±1.33 | 53.34±0.51 | 52.46±0.47 |
| $T_4$ | 54.26±0.44 | 53.81±0.88 | 56.02±0.32 | 54.69±0.39 |
| $T_5$ | 53.70±0.58 | 54.23±0.78 | 54.33±0.86 | 54.09±0.66 |
| $T_6$ | 55.09±1.46 | 53.23±0.81 | 54.33±0.55 | 54.22±0.89 |
| $T_7$ | 53.03±0.66 | 53.48±0.41 | 53.12±0.69 | 53.21±0.49 |
| $T_8$ | 51.95±0.99 | 51.87±0.70 | 54.04±0.86 | 52.62±0.67 |

NS-Non significant, [1]Average over eight occasions under each period

From Table 4, it is evident that neither during the individual periods (average over eight occasions) nor with the cumulative period, the egg weights were significantly ($p<0.05$) different from each other. The average egg weights ranged from 51.95 g ($T_8$) to 55.09 g ($T_6$) during Period I; from 51.75 g ($T_3$) to 54.23 g ($T_5$) during Period II and from 53.12 g ($T_7$) to 56.02 g ($T_4$) during Period III. The cumulative egg weights ranged from 52.46 g ($T_3$) to 54.70 g of control ($T_1$) in soya based diets, while in fish based diets, the values ranged from 52.62 g ($T_8$) to 54.22 ($T_6$) as against 54.09 g of control group ($T_5$).

In general, the egg weights under test dietary groups are comparable to that of control and that they further indicate that inclusion of SPR up to 15 percent does not significantly affect the egg weights.

**Egg shape index:** Egg Shape Index as one of the indices of egg quality being influenced by various treatments is presented in Table 5. Statistical analysis did not reveal any significant differences during different periods of the experiment. The average values ranged from 75.66 ($T_2$) to 77.12 ($T_3$) on 1st day; from 76.42 ($T_8$) to 78.67 ($T_4$) on 28th day; from 75.62 ($T_2$) to 77.99 ($T_6$) on 56th day and from 76.30 ($T_1$) to 78.16 ($T_7$) on 84th day.

Nevertheless, the eggs obtained in the present study with a shape index of 75 to 78 percent appear to be more conducive for the egg quality and further

Table 5: Average shape index of eggs at different time intervals from different dietary groups

| | Average shape index[1] at 28 day intervals$^{NS}$ | | | | |
|---|---|---|---|---|---|
| Treatments | 1st day | 28th day | 56th day | 84th day | Mean |
| $T_1$ | 76.56±0.68 | 77.02±0.80 | 77.03±0.30 | 76.30±0.33 | 76.73±0.18 |
| $T_2$ | 75.66±0.42 | 76.84±0.56 | 75.62±0.43 | 76.80±0.52 | 76.23±0.34 |
| $T_3$ | 77.12±0.56 | 77.03±0.69 | 76.51±0.50 | 76.71±0.53 | 76.84±0.14 |
| $T_4$ | 76.02±0.54 | 78.67±1.50 | 77.08±0.65 | 77.31±0.41 | 77.27±0.55 |
| $T_5$ | 77.03±1.23 | 77.02±0.46 | 77.32±0.81 | 77.81±0.52 | 77.29±0.18 |
| $T_6$ | 76.40±0.46 | 78.52±1.61 | 77.99±0.42 | 77.89±0.53 | 77.70±0.45 |
| $T_7$ | 76.30±0.37 | 77.49±0.56 | 77.46±0.48 | 78.16±0.49 | 77.35±0.39 |
| $T_8$ | 76.06±0.10 | 76.42±0.60 | 76.22±0.26 | 76.50±0.72 | 76.30±0.10 |

NS-Non significant, [1]Percent ratio of width to length of an egg

Table 6: Average albumen index of eggs at different time intervals from experimental birds

| | Average albumen index | | | | |
|---|---|---|---|---|---|
| Treatments | 1st day$^{NS}$ | 28th day$^{NS}$ | 56th day$^{NS}$ | 84th day* | Mean$^{NS}$ |
| $T_1$ | 0.035±0.002 | 0.031±0.001 | 0.035±0.003 | $0.033^{a}$±0.002 | 0.033±0.001 |
| $T_2$ | 0.037±0.005 | 0.032±0.003 | 0.036±0.004 | $0.036^{a}$±0.003 | 0.035±0.001 |
| $T_3$ | 0.035±0.001 | 0.038±0.003 | 0.040±0.004 | $0.053^{b}$±0.006 | 0.041±0.004 |
| $T_4$ | 0.037±0.003 | 0.040±0.002 | 0.037±0.003 | $0.037^{a}$±0.002 | 0.038±0.001 |
| $T_5$ | 0.032±0.005 | 0.034±0.004 | 0.036±0.002 | $0.037^{a}$±0.200 | 0.035±0.001 |
| $T_6$ | 0.035±0.003 | 0.036±0.003 | 0.040±0.004 | $0.034^{a}$±0.003 | 0.036±0.001 |
| $T_7$ | 0.033±0.002 | 0.030±0.002 | 0.040±0.005 | $0.034^{a}$±0.003 | 0.034±0.002 |
| $T_8$ | 0.037±0.004 | 0.032±0.002 | 0.040±0.003 | $0.039^{ab}$± 0.002 | 0.037±0.002 |

NS-Non significant, *Within a column, means bearing at least one common superscript are statistically similar (p>0.05)

Table 7: Average Haugh unit scores of eggs from different experimental birds during different time interval

| | Average Haugh unit score$^{NS}$ | | | | |
|---|---|---|---|---|---|
| Treatments | 1st day | 28th day | 56th day | 84th day | Mean |
| $T_1$ | 54.04±1.90 | 49.66±0.98 | 54.39±2.13 | 50.60±1.06 | 52.17±1.20 |
| $T_2$ | 55.52±3.76 | 49.17±2.77 | 53.25±3.01 | 55.43±2.40 | 53.34±1.49 |
| $T_3$ | 53.68±1.42 | 55.59±1.92 | 57.03±2.50 | 55.55±2.49 | 55.46±0.69 |
| $T_4$ | 54.76± 2.47 | 58.25±1.72 | 53.82±2.69 | 55.32±1.37 | 55.54±0.96 |
| $T_5$ | 54.77±3.80 | 53.79±2.63 | 53.89±1.69 | 56.38±2.17 | 54.71±0.60 |
| $T_6$ | 54.43±2.58 | 56.23±2.58 | 58.15±3.02 | 53.84±3.09 | 55.66±0.97 |
| $T_7$ | 51.91±2.00 | 49.77±2.25 | 55.90±1.87 | 53.17±2.60 | 52.69±1.28 |
| $T_8$ | 55.62±3.19 | 51.99±1.62 | 59.34±1.99 | 58.99±1.48 | 56.49±1.72 |

NS-Non significant

suggesting that the SPR at any given level in the diets would not affect the shape index of the eggs and thus hatchability also.

**Albumen index:** Average albumen index scores of eggs of experimental hens fed different diets during different periods of the experiment are presented in Table 6. The average values ranged from 0.032 ($T_5$) to 0.037 ($T_2$, $T_4$, $T_8$) on 1st day; from 0.030 ($T_7$) to 0.040 ($T_4$) on 28th day; from 0.035 ($T_1$) to 0.040 ($T_3$, $T_6$, $T_7$ and $T_8$) on 56th day and from 0.033 ($T_1$) to 0.053 ($T_3$) on 84th day of the experimental period. All the values were found to be non significant (p>0.05) excepting on terminal (84th) day. The mean Albumen index values pooled over the periods ranged from 0.033 ($T_1$) to 0.041 ($T_3$), which however non significantly (p>0.05) different from each other.

**Haugh unit score:** An interrelationship between egg weight and albumen height in terms of Haugh unit (HU) score, is an important egg quality measure for shelf life of eggs. The average Haugh unit scores under different dietary groups are presented in Table 7. The average values ranged from 51.91 ($T_7$) to 55.62 ($T_8$) on 1st day; from 49.17 ($T_2$) to 58.25 ($T_4$) on 28th day; from 53.25 ($T_2$) to 59.34 ($T_8$) on 56th day and from 50.60 ($T_1$) to 58.99 ($T_8$) on 84th day. The average values during any particular interval were however, found to be non significant. The pooled over (periods) mean values ranged non significantly (p>0.05) from 52.17 ($T_1$) to 56.49 ($T_8$). The non significant differences observed between different treatments during different time intervals revealed that Haugh unit scores are not affected by the inclusion of SPR in both soya and fish based diets.

Since no reports are available on the utilization of SPR in layers, it is rather inferred that the egg quality traits of laying hen can be maintained when SPR is included up to 10 percent in their diets.

**Conclusion:** The research outcome of the present study suggests that the inclusion of Sugarcane Press Residue (SPR) up to 10 percent in layer diets as a source of major as well as minor minerals apart from organic nutrients without affecting any egg quality characteristics.

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