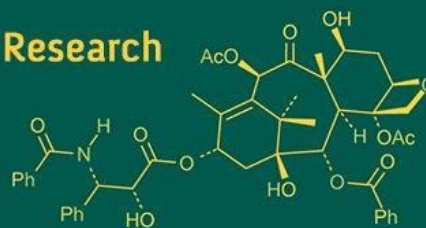


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## Effects of bakery waste incorporation on carcass traits and economic feasibility in broiler chickens

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### Abstract

Carcass traits and economic viability are the important elements to be considered for achieving profit and sustainability in poultry industry. The selection of unconventional feed ingredients to support poultry production is, in some ways, dependent on the carcass traits and economic feasibility. The present study, thus, investigated the potential effect of bakery waste as maize replacer on carcass traits and economic feasibility of Vencobb broiler chicken. A total of 240 one-day old chicks were randomly distributed evenly among 5 treatments (0, 5, 10, 15 and 20% bakery waste in diet, n = 4 replicates per treatment, with 12 broilers per replicate). The live weight, bled weight, defeathered weight, viscera weight and eviscerated weight of broiler birds from different dietary treatments was statistically similar. But bled weight expressed as % of live weight was significantly ( $p < 0.05$ ) higher in T2. The giblet weight did not differ significantly among different treatment groups. The cost economics of the experiment showed no adverse effect on the cost benefit ratio. The results indicate that the incorporation of bakery waste can maintain the carcass traits and economic feasibility of broiler rearing.

**Keywords:** Bakery waste, broiler, carcass, profit

### Introduction

Broiler chicken meat is rich in high-value protein, however, low in energy content as well as cholesterol. In terms of micronutrients, chicken meat also has relatively high amounts of potassium, magnesium, zinc, B group vitamins, and a high proportion of unsaturated fatty acids, including linoleic and linolenic (Farrell 2013; López *et al.*, 2011; Jeon *et al.*, 2010) [10, 14, 12]. Furthermore, it is tender and easily digestible making broiler meat favourable for consumers especially in developing nations (Kokoszynski *et al.*, 2013) [13]. The increasing demand is very well depicted by the statistics of poultry sector. As per a report by Expert Market Research, 2023, the India poultry market size reached a value of USD 28.18 billion in 2023. The industry is further expected to reach a value of approximately USD 44.97 billion by 2032, that is to grow at a CAGR of 8.1% in the forecast period of 2024-2032. The increasing demand as well as growth means higher requirement for poultry feed ingredients. This situation results in increasing cost of the feed ingredients as well as the higher costs of meat. To tackle this situation, there has been a constant search for unconventional ingredients so as to replace the commonly used ingredients to reduce the costs as well reduce competition with human food especially in developing nations.

There is a huge reliance on maize as a feed source for many meat/dairy animals as well as food for human consumption. In this context, there is a need to look for alternative feed ingredients to replace maize to cut down costs. Bakery waste because of its availability and high concentration of non-fibrous carbohydrates seems to be a promising unconventional ingredient (Arosemena *et al.*, 1995) [5]. The quality of broiler chicken carcass and meat, is influenced by various factors which include origin, age, rearing system, stocking density, sex of birds and nutrition. Under nutrition, factors like the feed ingredient, chemical composition of the diet, amount and physical form of the feed have a major effect on the carcass traits (Banaszak *et al.*, 2021; Kokoszynski *et al.*, 2013 and Poltowicz & Doktor, 2013) [17, 13, 20]. Hence, before propagating the use of bakery waste in the commercial production of broiler chicken, the carcass traits and the profit from broiler chicken rearing should be evaluated,

and this formed the basis for this study. Hence, the objective of this study was to examine the effect of bakery waste containing ration on carcass traits as well as economics of broiler chicken.

## Materials and Methods

### Procurement of feedstuffs

Bakery waste was procured from a local bakery manufacturing unit in Jammu. All other feed ingredients used for the formulation and preparation of experimental diets were purchased from nearby market.

### Feeding and management of Birds

The study was conducted in the Poultry Shed of Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, R S Pura, Jammu. The poultry shed was prepared before the arrival of two hundred forty, day-old broiler chicks. The brooding house was thoroughly cleaned and fumigated and temperature was set at 32 °C. Week by week, the temperature was reduced by 3 °C until it reached 24 °C, and it was maintained as such upto the end of the experiment. The brooding space was also gradually enlarged as the age of birds increased by slowly moving the brooder guards.

The experimental trial was conducted on 240-day-old chicks of commercial strain cobb-400 procured from reputable commercial hatchery. The birds were randomly allotted to treatment groups: Control, T1, T2, T3 and T4 having 0, 5, 10, 15 and 20% bakery waste as maize replacement respectively. The diets formulated were isonitrogenous and isocaloric, formulated to satisfy nutrient requirements of chicks as per ICAR (2013) [11]. All the groups were supplemented with soybean meal, meat bone meal, mineral mixture, vitamin supplements and common salt etc. formulated to satisfy the nutrient requirements of chicks as per ICAR (2013) [11], proximate composition of which is presented in Table 1. From day 0 to 14, pre-starter ration was provided and from day 15 to 21, starter ration was offered to the control and treatment groups. Similarly, the grower ration was offered from day 22 onwards. Sufficient quantity of fresh, clean and wholesome drinking water was provided throughout the trial.

### Carcass traits

At end of feeding trial of 42 days, eight birds per group (2 birds per replicate) were randomly picked up. The birds were starved overnight to empty the crop, then weighed and sacrificed for evaluation of carcass characteristics. The birds were sacrificed by severing jugular vein and carotid artery on one side of neck, allowed to bleed for 1 to 2 minutes, and then defeathered manually. The birds were dressed by cutting head at atlanto-occipital joint, legs at hock joint and carcass was eviscerated by making a slit opening at the abdominal area. The carcass traits viz. live weight, bled weight, carcass weight, dressing %, viscera weight and giblet weight were recorded in grams and calculated as percent of live weight of bird. The length of intestines (in centimeters) and immunological organs weight (spleen, thymus and bursa weight) were also noted.

### Economic Evaluation

The profit and cost benefit ratio of the different treatment groups was calculated by considering all the inputs (feed,

chicks and miscellaneous) as well as outputs.

## Statistical Analysis

The data pertaining to different parameters were subjected to statistical analysis as per the methods described by Snedecor and Cochran (1994) [23]. The significantly different means were subjected to Duncan's multiple range test (DMRT) as per Duncan (1955) [17].

## Results and Discussion

### Carcass traits

The various carcass characteristics of broiler chicken are presented in Table 3. The live weight, bled weight, defeathered weight, viscera weight as well as the eviscerated weight of broiler birds from different dietary treatments was statistically similar. The dressing percentage (%) as well as the drumstick weight (g) of broiler chicken of C, T1, T2, T3 and T4 group were similar ( $P>0.05$ ). These indicate that the muscle turnover was not adversely affected by bakery waste incorporation in broiler chicken ration. Epao *et al.* (2017) [8] and Prabhale *et al.*, (2019) [21] too reported similar dressing percentage amongst different treatment groups, while replacing maize with bakery waste in broiler ration. The non-significant impact of bakery waste incorporation on various carcass traits indicates that the different diets promoted fairly similar development of carcass traits. Likewise, earlier researchers too found similar carcass traits on bakery waste inclusion (different levels) in broiler ration as maize substitute (Al-Ruqaie *et al.* 2011; Oke, 2013; Ayanrinde *et al.*, 2014, Shittu *et al.*, 2016) [3, 18, 6, 22]. But, Ayanrinde *et al.* (2014) [6] reported significantly higher eviscerated weight in 100% bakery waste. But in above study, live weight was higher in 100% bakery waste fed group than 0% bakery waste fed group, resulting in higher eviscerated weight, which may be the probable reason for differences in the present and aforementioned results. Contrary to our results, Kricka *et al.*, 2019 [16] reported significantly higher drumstick weight and carcass yield for birds fed 10% bakery waste compared to birds fed 5% pelleted brown bread waste and 0% bakery waste as maize replacer.

The giblet weight (g) did not differ significantly among the different treatment groups. Similarly, the weight of heart and liver (g) showed no significant difference among the different experimental groups. It may be assumed from similar liver weights amongst different dietary groups that bakery waste has no anti-nutritional factor and may make a good replacement for maize in broiler ration (Olayemi *et al.*, 2007) [19], as if there are any toxic elements in this unconventional feed, abnormalities in liver weight are prominent (Ahamefule *et al.*, 2006) [1]. These findings were supported by the results of various researchers (Oke, 2013; Shittu *et al.*, 2016; Epao *et al.*, 2017 and Prabhale *et al.* 2019) [18, 22, 8, 21]. However, Kricka *et al.* (2019) [16] found irregular patterns in liver weight, being higher ( $p<0.05$ ) in 5% bakery waste fed birds and comparable in 0 and 10% bakery waste fed groups. Although, Ayanrinde *et al.* (2014) [6] reported similar liver weight; however significantly ( $p<0.05$ ) higher heart weight was reported in birds fed 100% bakery waste compared to other treatment groups (0, 33 and 67% bakery waste based rations), which might be due to higher body weight of the 100% bakery waste fed birds. However, the gizzard weight (g) was significantly higher ( $p<0.05$ ) in C than T4 and intermediate values were seen in

T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. The decreased gizzard weight obtained for birds fed 20% bakery waste as maize replacer could be as a result of the smaller particle size and higher inclusion level of bakery waste in the diet which might have led to decreased muscular function (grinding) of the gizzard.

There were no significant differences found across different treatment groups in the length (cm) of duodenum, jejunum, ileum and caeca despite feeding different levels of bakery waste as maize replacer in broiler ration (Table 2). This implies that the bakery waste inclusion had no adverse effect on the intestinal parameters and does not tamper with the intestinal integrity of the broiler chickens. Shittu *et al.* (2016) [22] too reported no significant difference in the length of duodenum, jejunum, ileum and caeca. However he found significant increase in length of large intestine, but in the present study large intestine was not measured.

The mean weight of lymphoid organs *viz.* thymus, spleen and bursa (g) were statistically similar, indicating no adverse effect on immunological organs due to substitution of maize with different levels of bakery waste (Table 3). No significant difference in weight of spleen was also reported by Shittu *et al.* (2016) [22] despite replacing maize with different levels of bakery waste. However, Ayanrinde *et al.* (2014) [6] reported significantly ( $p < 0.05$ ) higher values of spleen weight for bakery waste fed groups. It may be explained in the light of the fact that the replacement levels (33, 67 and 100%) and body weight of bakery waste fed groups was higher than maize-soya based basal diet fed

groups. The literature pertaining to thymus and bursa were not found to the best of our efforts, so the results cannot be discussed.

### Cost Economics

The cost benefit ratio of the different treatment groups is given in Table 4. The total input cost (Rs.) was lowest in T<sub>4</sub> and highest in C, which was because of throwaway prices of bakery waste in Jammu region. Sagan *et al.* (2021) [4] also reported reduction in feed cost on inclusion of bakery waste as maize replacer. Decrease in feed cost due to bakery waste incorporation was also reported by earlier researchers (Madiya *et al.*, 2005; Al-Ruqaie *et al.*, 2011; Oke, 2013; Shittu *et al.*, 2016 and Epao *et al.*, 2017) [15, 3, 18, 22, 8]. This indicates that the use of bakery waste helps in the cost reduction of broiler feed and production. But the weight of birds in C was higher than T<sub>1</sub>, T<sub>2</sub>, and T<sub>4</sub> and was least in T<sub>3</sub>. Also, the income generated by selling birds @ Rs. 98/kg live weight was higher in C followed by T<sub>1</sub>, T<sub>2</sub>, T<sub>4</sub> and least in T<sub>3</sub>. Likewise, the cost benefit ratio was highest in C, followed by T<sub>4</sub>, T<sub>1</sub>, T<sub>2</sub> and least in T<sub>3</sub>, but the values were comparable. Adeyemo *et al.* (2014) [6] reported higher profit margins while replacing maize with dry bakery waste in broiler diet. But the comparable values of Cost benefit ratio signify that maize can be safely replaced upto 20% bakery waste in broiler ration without any adverse effect in economics.

**Table 1:** Proximate composition of broiler pre-starter, starter and finisher diet (on DMB)

|     | PRE STARTER |                |                |                |                | STARTER |                |                |                |                | FINISHER |                |                |                |                |
|-----|-------------|----------------|----------------|----------------|----------------|---------|----------------|----------------|----------------|----------------|----------|----------------|----------------|----------------|----------------|
|     | C           | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | C       | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> | C        | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> |
| CP  | 21.55       | 21.70          | 21.79          | 21.83          | 21.87          | 21.32   | 21.51          | 21.59          | 21.70          | 21.75          | 19.37    | 19.41          | 19.67          | 19.79          | 19.87          |
| EE  | 5.25        | 5.41           | 5.53           | 5.65           | 5.72           | 6.11    | 6.21           | 6.39           | 6.47           | 6.61           | 6.31     | 6.34           | 6.57           | 6.79           | 7.23           |
| CF  | 4.18        | 4.25           | 4.15           | 4.04           | 4.19           | 4.28    | 4.21           | 4.19           | 4.25           | 4.13           | 4.33     | 4.17           | 4.22           | 4.15           | 4.24           |
| TA  | 4.90        | 4.94           | 5.09           | 5.47           | 5.51           | 4.29    | 4.31           | 4.42           | 4.53           | 4.62           | 4.61     | 4.67           | 4.89           | 5.21           | 5.34           |
| NFE | 64.12       | 63.70          | 63.44          | 63.01          | 62.71          | 64.00   | 63.76          | 63.41          | 63.05          | 62.89          | 65.38    | 65.41          | 64.65          | 64.06          | 63.32          |

**Table 2:** Effect of bakery waste inclusion on carcass characteristics of broiler chicken

| Attributes                           | Groups                   |                           |                           |                           |                          |
|--------------------------------------|--------------------------|---------------------------|---------------------------|---------------------------|--------------------------|
|                                      | C                        | T <sub>1</sub>            | T <sub>2</sub>            | T <sub>3</sub>            | T <sub>4</sub>           |
| Initial body weight (g)              | 49.15±1.05               | 48.37±1.22                | 48.67±0.52                | 48.67±0.34                | 50.61±0.80               |
| Final live weight (g)                | 2435.40±55.38            | 2326.20±90.57             | 2327.60±80.43             | 2261.00±71.81             | 2217.20±108.92           |
| Bled weight (g)                      | 2318.60±48.17            | 2215.80±86.50             | 2223.20±80.07             | 2150.40±62.26             | 2077.60±90.24            |
| De-feathered weight without skin (g) | 1861.80±54.25            | 1804.60±82.85             | 1806.20±46.71             | 1747.20±60.72             | 1693.60±84.73            |
| Viscera weight (g)                   | 245.60±20.04             | 257.00±23.988             | 242.80±5.23               | 251.00±32.20              | 214.40±40.69             |
| Eviscerated weight (g)               | 1616.20±36.87            | 1547.60±60.58             | 1563.40±46.40             | 1496.20±30.68             | 1479.20±101.51           |
| Dressing %                           | 71.31±0.39               | 71.46±0.60                | 72.30±0.84                | 71.64±0.78                | 71.65±1.34               |
| Giblet weight (g)                    | 122.60±1.78              | 117.60±4.45               | 120.20±3.31               | 117.80±4.26               | 114.20±2.15              |
| Heart weight (g)                     | 13.00±0.55               | 13.00±1.73                | 13.40±1.72                | 13.60±1.75                | 14.00±0.84               |
| Liver weight                         | 56.00±1.67               | 52.60±2.93                | 55.40±3.33                | 54.60±3.84                | 53.40±1.44               |
| Gizzard weight (g)                   | 53.60 <sup>b</sup> ±1.03 | 52.00 <sup>ab</sup> ±1.82 | 51.40 <sup>ab</sup> ±2.04 | 49.60 <sup>ab</sup> ±2.09 | 46.80 <sup>a</sup> ±1.02 |
| Drumstick weight (g)                 | 113.00±7.00              | 110.00±8.00               | 111.50±9.50               | 116.00±5.00               | 109.00±26.00             |
| Length of duodenum (cm)              | 32.05±1.62               | 33.58±0.61                | 29.80±0.59                | 32.20±2.08                | 31.25±0.93               |
| Length of jejunum (cm)               | 60.90±0.78               | 62.28±2.05                | 61.22±1.09                | 62.01±0.14                | 62.23±1.06               |
| Length of ileum (cm)                 | 103.48±2.15              | 101.76±0.42               | 101.73±1.46               | 104.29±2.06               | 101.90±0.47              |
| Length of caecum (cm)                | 29.48±1.23               | 30.66±0.56                | 29.26±0.91                | 32.82±1.44                | 30.86±0.52               |

**Table 3:** Effect of bakery waste inclusion on weight of immunological organs of broiler chicken

| Attributes        | Groups    |                |                |                |                |
|-------------------|-----------|----------------|----------------|----------------|----------------|
|                   | C         | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> |
| Thymus weight (g) | 4.60±0.40 | 4.80±0.58      | 4.40±0.81      | 4.60±0.40      | 4.80±0.20      |
| Spleen weight (g) | 3.60±0.51 | 4.60±0.51      | 4.40±0.81      | 4.40±0.51      | 3.80±0.58      |
| Bursa weight (g)  | 5.40±0.51 | 4.60±0.87      | 5.00±0.71      | 4.80±0.37      | 4.60±0.60      |

**Table 4:** Effect of bakery waste feeding on cost economics

| Attributes                                      | Groups     |                |                |                |                |
|-------------------------------------------------|------------|----------------|----------------|----------------|----------------|
|                                                 | C          | T <sub>1</sub> | T <sub>2</sub> | T <sub>3</sub> | T <sub>4</sub> |
| No. of chicks                                   | 48.00      | 48.00          | 48.00          | 48.00          | 48.00          |
| Cost of chicks @ Rs. 34/chick                   | 1632.00    | 1632.00        | 1632.00        | 1632.00        | 1632.00        |
| Cost of litter (Rs.)                            | 150.00     | 150.00         | 150.00         | 150.00         | 150.00         |
| Cost of pre starter feed (Rs.)                  | 724.00     | 692.00         | 682.00         | 673.00         | 664.00         |
| Cost of starter feed                            | 1222.00    | 1182.00        | 1109.00        | 1093.00        | 1071.00        |
| Cost of finisher feed                           | 5239.00    | 5165.00        | 5132.00        | 5300.00        | 5105.00        |
| Total cost of feed                              | 7185.00    | 7039.00        | 6923.00        | 7066.00        | 6840.00        |
| Miscellaneous cost (Rs.)                        | 100.00     | 100.00         | 100.00         | 100.00         | 100.00         |
| Mortality                                       | 0.00       | 0.00           | 0.00           | 0.00           | 0.00           |
| Total live birds                                | 48.00      | 48.00          | 48.00          | 48.00          | 48.00          |
| Total input cost (in Rs.)                       | 9067.00    | 8921.00        | 8805.00        | 8948.00        | 8722.00        |
| Mean slaughter body weight (kg)                 | 2.39       | 2.30           | 2.24           | 2.23           | 2.26           |
| Weight of birds (kg)                            | 114.72     | 110.40         | 107.52         | 107.04         | 108.48         |
| Income from birds (@ Rs. 98 per kg live weight) | 11242.56   | 10819.20       | 10536.96       | 10489.92       | 10631.04       |
| Total difference over control (Rs.)             |            | -423.36        | -705.60        | -752.64        | -611.52        |
| Difference over control/bird (Rs.)              |            | -8.82          | -14.70         | -15.68         | -12.74         |
| Profit per kg (Rs. per kg)                      | 18.97±1.06 | 16.70±2.78     | 16.00±2.15     | 14.47±2.87     | 17.54±1.39     |
| Cost benefit ratio                              | 1.24±0.02  | 1.21±0.04      | 1.20±0.03      | 1.18±0.04      | 1.22±0.02      |

### Conclusion

Bakery waste as a replacer of maize up to 20% level in ration of broiler chicken did not reveal any negative impact on carcass traits. Thus, the available bakery waste can be utilized up to 20 percent as replacer of maize in commercial rations of broiler chicken.

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