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# Blood biochemical profiles of White Pekin ducks during starter phase fed different cereal based diets

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In India, ducks are the second largest poultry species contributing towards egg and meat production reared as alternate poultry species in the country. In the year 2020, India's duck population ranked fifth in the globe (Naik *et al.* 2022). With 42.36% hike in the 20th livestock census. White Pekin ducks are globally the most popular meat type duck breed. Several researches has advocated that White Pekin ducks can be reared under village conditions for both meat and egg production by feeding locally sourced cereal based feed mixtures (Swain *et al.* 2018, Naik *et al.* 2020a, Naik *et al.* 2020b, Naik *et al.* 2021, Naik *et al.* 2022c). However, ducks are highly vulnerable to aflatoxicosis- a disease caused by fungus (Mishra *et al.* 2021). Maize is one of the most preferred cereals added in poultry diet as an energy source is highly prone for aflatoxin contamination. Therefore, wheat based feed mixture is principally favoured in duck diet over maize. However, the rising cost of wheat, makes the duck feed expensive. Hence, the duck farmers prefer to use broken rice (*kani*) generated as a by-product in the rice mill and locally available at a cheaper price.

Blood biochemical parameters reflect the health status and nutrient metabolism in animals and birds, which ultimately affects the production. However, literature on feeding of broken rice or rice kani to White Pekin ducks and its impact on blood biochemical profile, particularly in starter phase are scarce. Therefore, the study aimed to determine the impact of substitution wheat with broken rice graded on different blood biochemical parameters in White Pekin ducks during the starter phase.

Three different cereal-based feed mixture (iso-nitrogenous and iso-caloric) were prepared: (i) control feed with 100% wheat and with no broken rice (BR-0) (ii) with 75% wheat and 25% broken rice (BR-25) (iii) with 50% wheat and 50% broken rice (BR-50) (Table 1). The study population constituted 240 day-old White Pekin ducklings randomly sorted into three groups: each having four replicates with twenty ducks per replicate. The experimental feeds were fed *ad lib.* to the ducklings for a period of eight weeks. The ducklings were reared on deep litter system with provision of sufficient clean drinking water during the entire experimental period. Under standard management practices and necessary health care measures. All the three experimental diets were iso-nitrogenous (18.33-18.37, %CP) and iso-caloric (2614-2661, ME, Kcal/kg) as presented (Table 2).

Table 1. Physical compositions (%) of different diets

| Feed ingredient | Diets# | | |
|---|---|---|---|
| | BR-0 | BR-25 | BR-50 |
| Wheat (kg) | 60 | 45 | 30 |
| Rice Kani (kg) | 0 | 15 | 30 |
| Soybean (Kg) | 25 | 28 | 30 |
| Fishmeal (Kg) | 5 | 5 | 5 |
| DORB (Kg) | 8 | 5 | 3 |
| Oyster shell (Kg) | 1 | 1 | 1 |
| DCP (Kg) | 1 | 1 | 1 |
| Trace minerals ## (g) | 100 | 100 | 100 |
| DL-Methionine (g) | 50 | 50 | 50 |
| Lysine (g) | 50 | 50 | 50 |
| Vit. $AD_3B_2K$ (g) | 20 | 20 | 20 |
| Vit. E & Selenium (g) | 20 | 20 | 20 |
| Vit. B-complex (g) | 20 | 20 | 20 |
| Toxin binder (g) | 100 | 100 | 100 |
| Salt (g) | 100 | 100 | 100 |

# BR-0: Diet without broken rice; BR-25: Diet with broken rice replacing 25% wheat; BR-50: Diet with broken rice replacing 50% wheat

## Trace mineral contained Mn 11 g; Zn 10 g; Cu 2g; Fe 11 g; Se 0.15 g; I 0.25 g; Co 0.125 g; and Cr 40 mg per 100kg feed

At the end of the feeding trial, around 2.5 ml blood was drawn individually from wing vein of eight ducks from each group (two ducks per each replicate). Approximately 0.5 ml blood was collected in sodium fluoride containing

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Table 2. Chemical compositions (on % DM basis) of different diets

| Parameters | Diets# | | |
|---|---|---|---|
| | BR-0 | BR-25 | BR-50 |
| Dry matter and nutrient content (%DM) | | | |
| Dry Matter | 91.25 | 90.60 | 91.15 |
| Organic Matter | 86.43 | 86.06 | 87.99 |
| Crude Protein | 22.08 | 21.78 | 21.51 |
| Ether Extract | 3.19 | 3.15 | 3.36 |
| Crude Fibre | 6.25 | 5.96 | 5.74 |
| NFE | 54.91 | 55.17 | 57.38 |
| Total Ash | 13.57 | 13.94 | 12.01 |
| Calculated nutrient supply | | | |
| Energy (ME, kcal/kg) | 2811 | 2767 | 2719 |
| Lysine (%) | 1.22 | 1.27 | 1.31 |
| Methionine (%) | 0.46 | 0.47 | 0.48 |
| Ca (%) | 1.20 | 4.91 | 4.89 |
| Available P (%) | 1.15 | 1.19 | 1.18 |

#BR-0: Diet without broken rice; BR-25: Diet with broken rice replacing 25% wheat; BR-50: Diet with broken rice replacing 50% wheat

vial for blood glucose analysis. The remaining blood was collected in clot activator vials to allow clotting for serum collection. The serum samples were used for analysis of blood sugar, cholesterol, triglycerides, total protein, albumin, globulin, uric acid, calcium and phosphorus using kits developed by Coral Clinical Systems- a division of Tulip Diagnostics (P) Ltd., Pantnagar, Uttarakhand). The data were analysed for any statistical significance using methods described by Snedecor and Cochran (1994).

Feeding is one of deciding factors of the success of duck husbandry contributing to welfare of the birds (Garner *et al.* 2002, Sanotra *et al.* 2002). Impact of broken rice replacing wheat in diet of White Pekin ducklings was non-significant with respect to blood glucose, albumin, globulin, total protein, cholesterol, urea and uric acid content (Table 3). He *et al.* (2024) also recorded non-significant effect of feeding paddy rice replacing a corn-wheat based complete diet on the serum total protein, albumin levels.

Birds have higher plasma glucose level compared to other vertebrates of comparable body mass and they accumulate insignificant amount of intracellular glycogen (Braun and Sweazea 2008). According to the present study, the blood glucose (mg/dl) concentration of the Pekin ducklings was similar across the groups and ranged from 166.57±13.76 in BR-0 to 188.53±8.17 in BR-50 group. Naik *et al.* (2020b) recorded non-significant effect of replacing wheat with broken rice in the diet of Pekin layers during second year of laying and the blood glucose (mg/dl) concentration was close to the present study. The present findings agreed with the Kalita *et al*. (2020) in Nageswari ducks in Assam. However, Joshi *et al*. (2015) documented a higher blood glucose level (187.05-208.80, mg/dl) in 8-week-old Khaki Campbell ducklings. Compare to the present study, a lower blood glucose level in ducks have been documented by Mahant *et al.* (1994) in indigenous ducks of Assam, Mahanta *et al.* (1997) in Chara and Chemballi ducks, in Pekin ducklings (Sahoo *et al.* 2014 and Rath *et al.* 2016) Kalita *et al.* (2020) in Khaki Campbell ducks.

The total serum proteins contain antibodies, and hence are considered important blood parameters, reflecting the immune status of the species (Rath *et al.* 2019). The serum total protein, albumin and globulin levels (g/dl) were non-significantly higher in BR-0 group (7.02±0.42; 2.39±0.27 and 4.63±0.53) followed by BR-25 (6.71±044; 2.37±0.10 and 4.34±0.45) and lowest in BR-50(6.32±0.52; 2.05±0.03 and 4.27±0.53) group. The serum protein range reported by our study is close to findings of Behera et al. (2016) in 8-week-old Desi ducklings. Earlier studies have reported lower serum total protein in ducks (Mahanta *et al.* 1997, Joshi *et al.* 2015, Mohanty *et al.* 2015, Rath *et al.* 2016). A lower serum albumin content compared to our study was documented in studies by Joshi *et al.* (2015) and Rath *et al.* (2016); however, Mahanta *et al.* (1997) observed higher

Table 3. Effect of feeding graded levels of broken rice, replacing wheat on various blood biochemical profiles of ducks

| Parameters | Diets# | | | SEM |
|---|---|---|---|---|
| | BR-0 | BR-25 | BR-50 | |
| Glucose (mg/dl) | 166.57±13.76 | 187.12±12.50 | 188.53±8.17 | 6.80 |
| Total protein (g/dl) | 7.02±0.42 | 6.71±0.44 | 6.32±0.52 | 0.26 |
| Albumen (g/dl) | 2.39±0.27 | 2.37±0.10 | 2.05±0.03 | 0.10 |
| Globulin (g/dl) | 4.63±0.53 | 4.34±0.45 | 4.27±0.53 | 0.28 |
| Triglycerides (mg/dl) | 69.06±9.42 | 55.84±11.81 | 67.15±8.80 | 5.70 |
| Cholesterol (mg/dl) | 65.48±11.02 | 68.10±12.37 | 77.86±11.33 | 6.49 |
| Urea | 5.41±1.59 | 4.88±0.98 | 6.80±0.20 | 0.62 |
| Uric acid (mg/dl) | 4.74±0.32 | 4.48±0.25 | 5.69±0.64 | 0.26 |
| Calcium (mg/dl) | 7.61±0.07 | 7.77±0.14 | 7.56±0.10 | 0.06 |

# BR-0: Diet without broken rice; BR-25: Diet with broken rice replacing 25% wheat; BR-50: Diet with broken rice replacing 50% wheat

serum albumin content in laying Chara and Chemballi of Assam. During egg laying period, the serum albumin content in female birds may elevate up to 100% (Stanford 2014). Few previous researches have recorded low level of serum globulin (Mahanta *et al.* 1997) while the observations by Joshi *et al.* (2015) and Rath *et al.* (2019) were close to our findings. In earlier study, Naik *et al.* (2020b) reported that complete substitution of wheat by low-cost alternative broken rice in the feed of White Pekin layers during second year of laying exhibited non-significant effect on the blood biochemical parameters of the ducks and reported a higher serum albumin content.

In broiler chickens, the level of serum lipid metabolites like the levels of total cholesterol, triglycerides, lipoprotein fractions and fatty acids profile, are sensitive indicators of fat metabolism efficiency. These values are influenced by several factors viz; genotype, sex, age, feed etc. (Meluzzi *et al.* 1992; Krasnodębska–Depta and Koncicki, 2000). The lipid metabolism in birds is impacted by the type of breed (Hermier *et al.* 2003; Lien *et al.* 2005). The serum triglycerides content (mg/dl) in our study on White Pekin ducklings ranged from 55.84±11.81 in BR-25 group to 69.06±9.42 in BR-0 group. Sinha *et al.* (2017) reported higher serum triglyceride content in 8- week-old Pati ducklings. Our findings agree with the findings of Naik *et al.* (2020b) who did not observe any significant effect of replacing wheat by broken rice in the diet of White Pekin layer ducks during second year of their laying and the serum triglycerides content (mg/dl) was much higher than the ducklings (294.10 to 297.70) which may be because of age.

Cholesterol content in poultry blood has been studied very elaborately, because of its associations on meat quality and consumer consciousness for lean meat. Many chicken studies have reported that variability in total serum cholesterol is commonly more due to dietary variations rather than genetic differences (Rath *et al.* 2019). Serum cholesterol level was highest in BR-50 group (77.86 ± 11.33 mg/dl) and lowest in BR-0 group (65.48 ± 11.02 mg/dl). The higher serum cholesterol in BR-50 group might be due to lower crude fibre (5.74%) content in diet as compared to the other two (5.96 and 6.25% in BR-25 and BR-0) groups. Serum cholesterol level is inversely proportional to crude fibre level in diet (Delany *et al*. 2003). Dietary crude fibre can change serum cholesterol level by influencing bile acid level in the body. Dietary crude fibre can absorb bile acid, subsequently leading to a drop in bile acid. Cholesterol serves as a precursor of steroid hormones and bile acid. Therefore, when bile acid level falls down, it probably affects the serum cholesterol level. Joshi *et al.* (2015) and Sinha *et al.* (2017) reported higher serum cholesterol level content in 8-week- old Khaki Campbell and Pati ducklings, respectively, which may be due breed effect. Rath *et al.* (2016) reported much higher serum cholesterol and triglyceride in adult White Pekin ducks which may be because of age. He *et al.* (2024) also recorded increased total cholesterol in serum of ducks fed with paddy rice replacing a corn-wheat based complete diet. Naik *et al.* (2020b) observed no effect of substituting wheat with broken rice on the serum cholesterol level (130.81-147.60, mg/dl) in White Pekin layer ducks.

Uric acid is generated during purine and protein metabolism in poultry. The urea and uric acid content (mg/dl) was minimum in BR-25 group (4.88 ±0.98; 4.48±0.25) and highest in BR-50 group (6.80±0.20; 5.69± 064). Behera *et al.* (2016) reported much higher serum uric acid level (7.70 to 9.37 mg/dl) in 8-week-old desi ducklings. Joshi *et al.* (2015) reported much higher serum urea level (6.09 to 10.20 mg/dl) in 8-week-old Khaki Campbell ducklings, probably breed variation. Naik *et al.* (2020b) reported non-significant effect of replacing wheat by broken rice in duck diet and recorded uric acid content in Pekin layers during second year of laying.

Serum calcium has crucial role in blood coagulation, muscle and nerve conduction, bone homeostasis and regulation of secretion of hormone - parathyroid and vitamin D 3 (Stanford 2014). Release of calcium in blood has multifaceted role in avian physiology viz; muscle contraction, eggshell production, blood coagulation, cellular permeability of liquids from interior of the cells to exterior and vice versa, maintaining acid base balance, nerve impulse transmission etc. Furthermore, it plays a vital role in immune system for calcification of organic lesions caused by infectious agents or parasites and acts as a stimulant for the T lymphocytes activities (Valls 2022). Ca (7.56±0.10 – 7.77±0.14, mg/dl) contents of the serum were also consistent amid the different groups. However, few earlier workers have reported a higher serum calcium content in ducks like Sahoo *et al.* (2014) in White Pekin, Joshi *et al.* (2015) and Mohanty *et al.* (2015) in Khaki Campbell ducks. Comparable results have been recorded by Giri *et al.* (2015) in grower Khaki Campbell ducks. However, Mahanta *et al.* (1997) documented much higher level of calcium (range13.42 to 16.15 mg/dl) in laying and pre-laying Chara and Chemballi ducks. The increased level of Ca in laying birds might be because of estrogen induced formation of vitellogenins that are integrated into the egg yolk and bind with calcium resulting in elevated serum calcium level. In addition, estrogen also influences the mobilization of medullary bone during the egg-laying cycle (Stanford 2014).

The present study concluded that substitution of wheat with broken rice (rice kani) in the starter diet of White Pekin ducks had no significant effect on the blood biochemical profile and may be used to economize the feeding cost of ducks in coastal belts where broken rice is available abundantly at a cheaper price than wheat.

## SUMMARY

The present study was conducted to evaluate the effect of feeding different cereals (wheat and broken rice) based feed on blood biochemical parameters of White Pekin ducks during starter phase. Day-old White Pekin ducks (N= 240) were sorted into three experimental groups having

four replicates per group and 20 ducklings per replicate. Three types of feed mixture were prepared, Control diet with no broken rice (BR-0) and two experimental diets with broken rice, replacing 25 (BR-25) and 50 (BR-50) percent wheat. Ducks were fed for a period of eight weeks. Replacement of wheat by graded level of broken rice didn't exhibit any significant impact on any of the blood biochemical parameters of Pekin ducks in the study. The blood glucose (mg/dl) level ranged from 166.57±13.76 in BR-0 to 188.53±8.17 in BR-50 group. The serum total protein, albumin and globulin levels (g/dl) were higher ($P<0.05$) in BR-0 group (7.02±0.42; 2.39±0.27 and 4.63±0.53) than BR-25 (6.71±044; 2.37±0.10 and 4.34±0.45) and lowest in BR-50(6.32±0.52; 2.05±0.03 and 4.27±0.53) group. The serum triglycerides content (mg/dl) ranged from 55.84±11.81 in BR-25 group to 69.06±9.42in BR-0 group. The serum cholesterol level was highest in BR-50 group and lowest in BR-0 group. The urea and uric acid content (mg/dl) was least in BR-25 group (4.88 ±0.98; 4.48± 0.25) and highest in BR-50 group 6.80±0.20; 5.69± 064). The study concluded that dietary substitution of wheat with broken rice had no significant effect on the blood biochemical parameters of White Pekin ducks during starter phase.

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