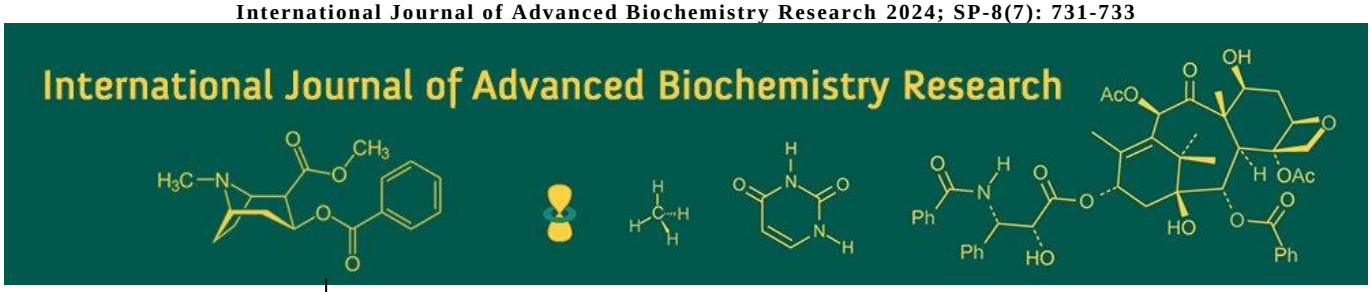

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Comparative study on growth performance of broiler rabbits and biochemical parameters in New Zealand white rabbits

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Abstract
Data studied on 99 bunnies belonging to New Zealand White (NZW), APAU Black (BL) and Flemish Giant (FG) were analyzed to assess the influence of genetic groups on pre weaning and post weaning body weights. The overall least-squares mean body weights at birth, 1, 2, 3 and 4 weeks of age were 46.38±1.085, 92.39±1.42, 172.8±3.46, 267.8±6.344 and 377.4±9.164 g respectively. The overall least-squares mean body weights at 6, 8, 10, 12 and 14 weeks of age were 565.1±13.27, 771.2±13.51, 996.2±18.5, 1255±20.19, 1504±21.38 g respectively. There was a significant effect of genetic groups on body weights at different pre weaning and post weaning ages in rabbits. Serum biochemical and mineral assay was analyzed. Significant weekly fluctuation was observed as the age increased in serum biochemical components including alanine aminotransferase (ALT), lactic dehydrogenase (LDH), creatine phosphokinase (CPK), creatinine (CR), uric acid (UA), amylase, total protein (TP) and minerals including Ca, P, Mg, Fe, Na, and Cl (p<0.05).

Keywords: Rabbits, body weights, pre weaning, post weaning, biochemical, mineral assay

1. Introduction
Rabbits are source of low fat and high protein type meat. Thereby its production commercially is encouraged owing to traits like high prolificacy, early maturity, rapid growth rate, high genetic potential for selection, limited competition with humans for similar foods and high-quality nutritious meat [1]. Rabbits are medium sized, hopping by nature with long legs, long ears, a short tail and they require small compartments unlike cattle and other small ruminants which require a large area of land. They are easy to manage with kitchen and vegetation wastes, crop residues, organic wastes from the food industry, converting these into rich high protein meat fit for human consumption [2]. Rabbits are largely maintained by small scale farmers and rural women can also be encouraged to meet their nutritious demand and incur income. Rabbit meat is almost cholesterol free and advisable for heart patients [3]. The sodium, calcium and phosphorous contents of rabbit meat are comparatively less than other meats [4]. Rabbits are fine boned and meat to bone ratio is high that is more edible meat on the carcass when compared to chicken. Selenium in rabbit meat works as an anti-oxidant. Some types of cancer, as well as ravages of aging people can be battled with selenium [5]. On an average, the rabbit meat contains calcium (21.4 mg/100 g), phosphorus (347 mg/100 g), fat (9.2 g/100 g) and cholesterol (56.4 mg/100 g) [6]. The performance levels of these broiler rabbits of different genetic groups at the pre-weaning and post weaning ages [12] need to be established for overall improvement of the rabbit production and a profitable enterprise.

2. Materials and Methods
Data on pre weaning and post weaning body weights of 22 New zealand white (NZW), 31 APAU Black (BL) and 46 Flemish giant (FG) were studied during 2022-2023 in Livestock Farm Complex, College of Veterinary Science, Korutla under routine farm activities. All the does of three genetic groups were reared uniformly in galvanized iron cages. The body weights from birth to weaning age of 4 weeks at weekly intervals and at 6, 8, 10, 12 and 14 weeks of post weaning ages were recorded and were subjected to least squares analysis [7] to study the influence of genetic groups on the performance evaluation of body weight traits.

Blood sample approximately 5 ml was collected from the marginal ear vein of New Zealand White rabbits once a week for 13 consecutive weeks. The blood samples were left in slant position at room temperature for 30-60 min for serum separation. A relative centrifugation force (RCF) of 1,800 *g* (3,000 rpm, 15 min) was used for serum separation. After centrifugation, the supernatant plasma/serum was aspirated carefully and transferred to Eppendorf tubes for storage. The serum was kept in the fridge (4 °C) overnight prior to analysis. Changes of the biochemical and cellular components of blood samples were evaluated over the experimental period. The biochemical assay including AST, ALT, LDH, CK, glucose, BUN, creatinine, cholesterol, etc., and mineral elements were examined by automatic analyzer.

Statistical analysis

The data were statistically analyzed using the general linear model (GLM) procedure of SAS (1988). The statistical analysis model is Yij= μ + Wi+ Rj+ εij where Yij, μ, Wi, Rj and εij are dependent variable, overall mean, week effect, individual rabbit effect and random error, respectively. Differences between the means by week are measured and compared using the least square means. Extreme significance, high significance and significance are declared at $P < 0.001$, $P < 0.01$ and $P < 0.05$, respectively, unless specified otherwise.

3. Results and Discussion

There was a significant effect of genetic groups on all the pre weaning and post weaning body weights studied. The overall least-squares mean body weights at birth, 1, 2, 3 and 4 weeks of age were 46.38±1.085, 92.39±1.42, 172.8±3.46, 267.8±6.344 and 377.4±9.164 g respectively (Table I). The overall least-squares mean body weights at 6, 8, 10, 12 and 14 weeks of age were 565.1±13.27, 771.2±13.51, 996.2±18.5, 1255±20.19, 1504±21.38 g respectively (Table II).

The means of weight in three genetic groups ranged from 42.36±1.384g (NZW) to 52.55±1.924g (BL), 87.77±2.16 g (FG) to 96.73±2.33g (BL), 154.2±4.36 g (FG) to 182.7±7.02 g (BL), 229.5±7.702 g (FG) to 294.0±11.72 g (NZW) and 324.5±13.13 g (FG) to 421.0±16.10 g (NZW) at birth, 1, 2, 3 and 4 weeks of age, respectively (Table I) while the weights at 6, 8, 10, 12 and 14 weeks of age ranged from 506.3±22.21 g (FG) to 619.0±22.93 g (BL), 715.9±22.22 g (FG) to 816.8±19.83 g (BL), 914.5±27.8 g (FG) to 1061±36.67 g (NZW), 1217±39.87 g (FG) to 1314±34.47 g (NZW) and 1453±33.81 g (FG) to 1596±41.95 g (NZW), respectively (Table II).

The results obtained were in accordance with the published literature which revealed more or less similar body weights at birth and first week of age in different genetic groups and the body weights observed at birth, 1, 2, 3 and 4 weeks of age were in accordance with the published literature ranging from 47.77 to 66.5, 88.84 to 106.2, 142.86 to 175.35, 209.54 to 296.31 and 294.88 to 527.92 g respectively [8, 9, 10]. Bunnies of BL genetic group recorded higher body weights [11]. Higher ADGs were observed in small litter size during pre weaning period when compared to medium and large litters [13].

Biochemical parameters including ALT, glucose, BUN, gGT, Chol, TG, ALB, lipase, and total bilirubin (T-bil) had no significant changes during this period. Only the biochemical components showing significant changes over the 13-week period are presented in Table III. All the mineral levels analyzed, except potassium (K), changed significantly over time (Table IV). ALT levels increased approximately starting from the fifth week and kept increasing up to the 13th week. On the contrary, LDH levels reduced from the second week and then recovered at the end of this period. The CPK values were, basically, increased from the 2nd week and peaked at the middle of the entire period. Other parameters including creatinine, total protein, globulin, uric acid, and amylase concentrations, all increased at the first week, but only the A/G ratios reduced after the onset of blood collection (Table III). Serum mineral concentrations revealed similar trends as those of biochemical parameters [14]. Calcium concentrations in serum reduced after the second week. Sodium and chloride concentrations also slightly reduced at the first week and then returned to the normal levels thereafter and other serum minerals including phosphorus, magnesium, and iron, all increased after the first week of blood collection (Table IV).

Table 1: Pre weaning mean body weights (g) of rabbits

Genetic group	At birth			At 1st Week			At 2nd Week			At 3rd Week			At 4th Week		
	N	Mean	SE	N	Mean	SE	N	Mean	SE	n	Mean	SE	n	Mean	SE
New zealand white (NZW)	22	42.36^{a}	1.384	22	92.68^{ab}	2.60	22	181.5^{b}	7.02	22	294.0^{b}	11.72	22	421.0^{b}	16.10
APAU Black (BL)	31	52.55^{b}	1.924	25	96.73^{c}	2.33	20	182.7^{b}	4.22	18	280.0^{b}	8.218	16	386.8^{b}	10.95
Flemish giant (FG)	46	44.23^{a}	1.589	43	87.77^{a}	2.16	39	154.2^{a}	4.36	38	229.5^{a}	7.702	38	324.5^{a}	13.13
Overall	99	46.38	1.085	90	92.39	1.42	81	172.8	3.46	78	267.8	6.344	76	377.4	9.164

Means with same superscript(s) do not differ significantly ($P \leq 0.05$)

Table 2: Post weaning mean body weights (g) of rabbits

Genetic group	At 6th Week			At 8th Week			At 10th Week			At 12th Week			At 14th Week		
	N	Mean	SE	N	Mean	SE	n	Mean	SE	n	Mean	SE	N	Mean	SE
New zealand white (NZW)	22	569.8^{b}	17.67	22	780.9^{b}	23.61	22	1061^{b}	36.67	22	1314^{b}	34.47	22	1596^{b}	41.95
APAU Black (BL)	16	619.0^{b}	22.93	14	816.8^{b}	19.83	12	1013^{b}	23.02	10	1234^{a}	27.34	9	1463^{a}	27.01
Flemish giant (FG)	37	506.3^{a}	22.21	34	715.9^{a}	22.22	30	914.5^{a}	27.80	22	1217^{a}	39.87	15	1453^{a}	33.81
Overall	75	565.1	13.27	70	771.2	13.51	64	996.2	18.50	54	1255	20.19	46	1504	21.38

Means with same superscript(s) do not differ significantly ($P \leq 0.05$)

Table 3: Serum biochemical components of New Zealand White rabbits over a 13-week period of blood collection.

Week	0	1	2	3	4	5	6	7	8	9	10	11	12	P level
ALT, U/L	18.3	19.5	12.5	18.8	17.2	22.3	26.4	24.5	27.1	29.4	28.6	27.6	36.0	0.0002
LDH, U/L	250	274	145	103	202	165	255	126	240	201	180	197	184	0.0025
CPK, U/L	188	457	435	335	705	474	682	408	677	486	561	537	406	0.0049
Creatinine, mg/dL	0.76	0.74	1.42	1.47	1.51	1.43	1.51	1.42	1.45	1.51	1.61	1.54	1.57	0.0001
TP, g/dL	6.09	5.72	04	5.91	6.13	6.08	6.11	6.15	6.51	6.45	6.39	6.24	6.31	0.0046
Glob, g/dL	2.24	1.85	2.45	2.65	2.61	2.51	2.43	2.66	2.72	2.91	2.56	2.66	2.63	0.0001
UA, mg/dL	0.16	0.15	0.93	0.71	0.86	0.86	0.82	0.75	0.86	1.06	1.13	0.89	0.95	0.0002
Amylase, U/L	174	185	326	326	418	320	335	302	302	333	326	323	338	0.0001
A/G	1.73	2.12	1.48	1.27	1.38	1.42	1.46	1.36	1.44	1.25	1.48	1.37	1.44	0.0001

Table 4: Serum mineral composition of New Zealand White rabbits over a 13-week period of blood collection.

Week	0	1	2	3	4	5	6	7	8	9	10	11	12	P levels
Ca, mg/dL	16.1	16.6	12.3	12.2	12.3	12.6	12.3	12.7	12.6	12.5	12.5	12.6	12.3	0.0002
P, mg/dL	2.14	1.87	3.82	3.71	4.08	4.25	3.6	4.06	4.24	4.06	4.33	4.44	3.96	0.0018
Mg, mg/dL	0.98	1.36	2.26	2.36	2.46	2.51	2.16	24	2.41	2.31	2.59	2.36	2.25	0.0001
Fe, mg/dL	131	160	138	161	172	168	173	185	178	171	177	179	163	0.0019
Na, mmol/dL	143	138	141	141	143	137	138	142	137	144	144	141	142	0.0001
Cl, mmol/dL	110	110	109	110	109	108	109	110	111	116	110	111	111	0.0001

4. Conclusion

The pre-weaning and post weaning growth traits are significantly influenced by the genetic group. Hence, selection of appropriate genetic group and proper managemental practices would be beneficial for profitable enterprise. Most of the biochemical parameters investigated showed constant values but, some selected biochemical components of the serum exhibited prominent changes during this period of study.

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