EFFECTS OF NUTRIENT DENSITY, GROWING PHASE AND RAISING SYSTEM ON THE PERFORMANCE AND FEATHER PRODUCTION AND QUALITY OF MALE DUCKS

Yono C. Raharjo and B. Wibowo[1]

Abstract

An experiment varying in nutrient density fed at 3 growing phases (starter, grower and finisher) to ducklings raised with or without water pond facilities was carried out to study duck meat and feather production. Basic diets were T1 = 12% crude protein/2000 kcal ME, T2 = 16 %/2500 kcal ME and T3 = 20 %/3000 kcal ME. Four treatment combinations were T1-T1-T1, meaning at starter (0-4 weeks), grower (4 – 8 weeks) and finisher (8 – 12 weeks) phase the ducks were fed diet T1, T1, and T1 respectively, T1-T2-T2, T1-T2-T3 and T2-T2-T1. Each treatment combination consisted of 3 replicates, each of 15 day-old ducklings. Ducks were raised in the pen facilitated with or without water pond. Measurements were made on growth performance and on proportion of feather fraction (down feather, plumes etc) and also on cost-benefit value. Results showed that combination of diet density, as well as water pond affected bodyweight (BW) and feather production (FP) significantly. At final week (12 week), T1-T2-T3 treatment produced highest BW both for water pond system (1479 g/h) and for non-water pond system (1388 g/h) and poor performance were observed from T1-T1-T1 and T2-T2-T1 treatments. Interesting to note, better nutrient density caused shorter small intestine length significantly. Feather production did not correspond linearly with the nutrient density or with the water pond. Highest production was from T1-T2-T2 and T1-T2-T3 (43 g/h) in the non-water pond and was highest from T2-T2-T1 (45.3 g/h) for the water pond system. The best quality feather (down feather) production however, was not influenced by water pond availability. Highest production was from duck fed T1-T2-T3 (4.71 g/h) and T2-T2-T1 (4.22 g/h) that were raised without water pond facility, and from ducks fed T2-T2-T1 (4.67g/h) and T1-T2-T3 (4,41 g/h) raised with the pond facility. Economic analysis indicated highest profit was earned from T1-T2-T2 treatment for both type of raising.

Key words: Duck, Meat, Feather production, Nutrient density

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[1] Balai Penelitian Ternak (Research Institute for Animal Production). PO Box 221 – Bogor 16002 Indonesia.

Introduction

Duck is the second poultry production in Indonesia, with approximately makes up 32 million in population by year 2000 (Ditjennak, 2001). In general, ducks in Indonesia are raised for egg production. The meat, usually comes from the males or unproductive old females, draws more attention for alternative meat consumption. Male duckling is a by-product from the duck hatchery, produced about 50 % from the total hatch, low in price and usually slow in growth (Sumanto *et al.*, 1992). Slow growth is usually due the breed, an egg layer type, and low density of dietary nutrient fed. At small scale farming, as low as 12 % dietary crude protein (CP) content is commonly practised (Setioko *et al.*, 1985). Its nutrient requirement, on the other hand, ranges from 15 – 20 % dietary crude protein at about 2700 kcal ME/kg (Sinurat *et al.*, 1989) or even 22 % dietary CP and 3200 kcal ME/kg for broiler type duck, such as Pekin (NRC., 1994). At 12 % dietary CP/2000 kcal ME/kg, Bintang *et al.* (1997) reported a mean bodyweight gain of male ducks from 3 local breeds was only two-third of those corresponding breeds receiving 16 % dietary CP/2500 kcal ME/kg.

Phase of growth usually corresponds to the nutrient requirement. Starting phase needs more nutrients than the older phase. However, since compensatory growth may also occurred, slow growth due to feeding low nutrient density diet at starter phase may then hypothetically be compensated by higher density diet at finisher phase. Thus, to maximize efficiency, farmers often formulate diet by these growth phases. It is however unknown to what degree would the effect may occur to the local male egg-type ducks. In this experiment, three nutrient densities, T1 = 12 % CP/2000 kcal ME, T2=16 % CP/2500 kcal ME and T3= 20 % CP/3000 kcal ME and three growth phases, i.e. starter (0 – 4 week old, grower (4 – 8 week old) and finisher (8 – 12 week old) were combined according to previous experimental results from female ducklings (Raharjo *et al.*, 1998).

Beside egg and meat, duck also produces feather. It's down feather and plumules has considerably high price, worth more than USD 5.50 per kg (Raharjo 1991), to be used as filler for expensive pillows, sleeping bag, jacket, etc. Most farmers in Taiwan raise ducks in pens facilitated with water pond or be herded in dams and riverbanks accessible to water (Tai, 1985). Raising duck in the area accessible to water may be hypothesised to comfort duck, hence more production and also better quality of feather can be expected.

Materials and Method

Three hundred and thirty six male day-old ducklings, from the Tegal breed, were allocated into 8 treatment combinations in a Completely Random Design. Each treatment combination consisted of three replicates of 15 ducklings. Treatments included four combinations of nutrient density x growing phase and raising the animals in the pen with or without water pond facility. Three nutrient densities were used, i.e. T1 = diet containing 12 % CP/2000 kcal ME/kg diet, T2 = diet containing 16 % CP/2500 kcal ME/kg diet, and T3 = diet containing 20 % CP/3000 kcal ME/kg diet. Combinations of nutrient density x growing phase were T1-T1-T1, T1-T2-T2, T1-T2-T3 and T2-T2-T1. T1-T1-T1 means that ducks raised at starter (0-4 week-old), grower (4 – 8 week-old) and finisher (8 – 12 week-old) phase are fed diet T1, diet T1 and diet T1 respectively. Diets were composed from corn, rice bran, wheat pollard, fishmeal, soybean meal, oil, dicalcium phosphate, lime, salt, vitamin mineral premix and lysine and methionine supplement. The chemical composition of diet is presented in Table 1. At 12 week-old ducks are slaughtered, three samples from each replicate were taken for carcass and abdominal content (liver, gizzard, heart and fat) and feather (total, down, plumules, and 'cotton-like') measurements. Feather fractions were obtained from separating feathers by weight, through the use of laminair blower, i.e. heaviest feather fall closest to the blower while down feather and 'plumules' are the farthest. Results were subjected to statistical analyses performed through SAS and differences between means were analysed by LSD (Steel and Torrie, 1982). Cost-benefit value was calculated.

Table 1. Composition of the experimental diets

Calculated Chemical composition:	T1	T2	T3
Crude protein, %	12.00	16.00	20.00
Metabolisable Energy, kcal/kg	2000	2500	3000
Crude fiber, %	8.90	8.20	7.60
Calcium, %	0.80	0.80	0.80
Available phosphorus, %	0.40	0.40	0.40
Lysine, %	0.85	0.93	1.25
Methionin, %	0.49	0.48	0.48
Price, Rp	1230	1355	1770

Results and Discussion

Growth responses, measured as bodyweight and carcass weight are presented in Table 2 and Table 3, respectively. Significantly heaviest bodyweight and carcass weight were attained by ducks fed diets T1-T2-T2 and T1-T2-T3, irrespective of the availability of water pond. This result indicated that growth response is more significant at grower (T1-T2-T2) and at finisher (T1-T2-T3) phases than those at starter phase (T2-T2-T1). Water pond did not affect the performance as indicated by no significant difference noted between the two treatments within any of the nutrient density x growing phase combination.

Table 2. Mean bodyweight of duck raised in the pens with or without water pond and fed various dietary treatments at 12 week-old (g/h)

Pen / Treatments	T1-T1-T1	T1-T2-T2	T1-T2-T3	T2-T2-T1	Mean
With water pond	1208[a]	1430[bc]	1480[c]	1215[a]	1335
Without water pond	1289[ab]	1364[bc]	1387[bc]	1331[b]	1345
Mean	1249	1397	1434	1273	

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME
[a,b,c] between rows and columns differ significantly

Similar response pattern was noted for carcass weight as shown in Table 3. Leeson *et al.* (1996) working with broiler chickens and Hussein *et al.* (1996) with pullets reported similar results; higher nutrient density produced better growth for the animals.

Table 3. Mean carcass weight of duck raised in the pens with or without waterpond and fed various dietary treatments at 12 week-old (g/h)

Pen / Treatments	T1-T1-T1	T1-T2-T2	T1-T2-T3	T2-T2-T1	Mean
With water pond	713[a]	896[bc]	942[c]	744[a]	823
Without water pond	846[b]	909[bc]	939[c]	861[bc]	888
Mean	779	902	940	802	

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME
[a,b,c] between rows and columns differ significantly.

Nutrient density and bodyweight seemed to correlate with the length of small intestine. Higher density and heavier weight caused less length of the intestine (Table 4). At T1-T1-T1 (the lowest density for the three phases and T2-T2-T1 (in which at finisher phase receiving lowest density), the intestine were significantly longer than other treatments results.

Lower density usually has lower digestibility, hence causes the intestine to work more active that leads to longer in length (Moran, 1982). Bintang *et al.* (1997) reported similar results with ducks slaughtered at 8 week-old.

Table 4. Mean small intestine length of duck raised in the pens with or without water pond and fed various dietary treatments (cm/h).

Pen / Treatments	T1-T1-T1	T1-T2-T2	T1-T2-T3	T2-T2-T1	Mean
With water pond	83.1[ab]	74.0[abc]	65.1[c]	84.5[a]	76.7
Without water pond	79.7[ab]	72.9[bc]	66.9[bc]	76.9[abc]	74.1
Mean	81.4	73.5	66.2	80.7	

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME
[a,b,c] between rows and columns differ significantly.

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Other results on the abdominal contents are shown in Table 5. Except for abdominal fat, which were higher in the animals fed T1-T2-T2 and T1-T2-T3 (similar to the body and carcass weight), other contents were not different significantly.

Table 5. Mean weight of other abdominal contents of duck raised in the pens with or without water pond and fed various dietary treatments (g/h).

Pen	Dietary treatments	Liver	Gizzard	Fat	Heart
	T1-T1-T1	38.7[a]	71.5[a]	0.47[a]	9.1[a]
With	T1-T2-T2	38.6[a]	76.4[a]	3.90[b]	10.5[a]
water pond	T1-T2-T3	31.1[b]	67.9[a]	4.25[b]	10.6[a]
	T2-T2-T1	40.5[a]	72.1[a]	0.90[a]	8.5[a]
	Mean	37.3	72.7	2.38	9.7
	T1-T1-T1	38.1[a]	73.6[a]	0.37[a]	9.3[a]
Without	T1-T2-T2	36.9[a]	71.8[a]	4.00[b]	9.6[a]
water pond	T1-T2-T3	37.1[a]	72.6[a]	4.75[b]	11.1[a]
	T2-T2-T1	37.3[a]	71.0[a]	3.28[a]	9,9[a]
	Mean	37.4	72.0	3.10	10.0

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME
[a,b,c] within columns differ significantly.

Low nutrient density also produced lower total feather yield (Table 6), as indicated by lower feather yield from T1-T1-T1. Interesting to note, however, unlike bodyweight, higher density at starter phase followed by lower density at finisher phase, as in the case of T2-T2-T1, produced feather as many as those from higher density at grower-finisher phase. Surprisingly also at low (T1-T1-T1) and moderate (T1-T2-T2) density diet more feather yield was obtained from duck raised without water pond facility. Irrespective of treatments, results of feather yield from this experiment is much higher than those reported from the survey results carried out in 1989 (Raharjo, 1991)

Table 6. Mean total feather weight of duck raised in the pens with or without water pond and fed various dietary treatments (g/h)

Pen / Treatments	T1-T1-T1	T1-T2-T2	T1-T2-T3	T2-T2-T1	Mean
With water pond	31.5[a]	34.1[a]	41.5[bc]	42.9[bc]	37.5
Without water pond	39.9[bc]	45.2[c]	41.5[bc]	40.4[bc]	41.8
Mean	35.7	39.7	41.5	41.7	

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME
[a,b,c] between rows and columns differ significantly.

Fractions of feather, particularly the good quality ones, such as 'down', plumules and 'cotton-like' feather as the response to treatments are shown in Table 7. Small but significant differences were noted in some dietary treatment x growing phase, but not between the presences of water pond. Highest down feather yield was from duck fed T1-T2-T3 treatment and raised in the pen with no water pond and from T2-T2-T1 with water pond facility. Percentage of down feather yield from the total feather in this experiment was about 11 %, is also higher than those obtained from the survey data (Raharjo, 1991), which was only about 6 – 9 %.

Table 7. Mean weight of feather fractions of duck raised in the pens with or without water pond and fed various dietary treatments (g/h)

Pen	Dietary treatments	Down feather	Plumules	Cotton-like feather	Other fractions
	T1-T1-T1	3.54^{a}	3.18^{a}	2.34^{a}	22.43
With	T1-T2-T2	3.83^{a}	3.19^{a}	2.34^{a}	24.74
water pond	T1-T2-T3	4.41^{ab}	3.23^{a}	2.32^{a}	31.54
	T2-T2-T1	4.67^{b}	4.10^{b}	3.21^{a}	30.92
	Mean	4.11	3.43	2.55	27.40
	T1-T1-T1	3.35^{a}	3.08^{a}	2.77^{a}	30.70
Without	T1-T2-T2	4.03^{ab}	3.87^{ab}	3.22^{a}	31.08
water pond	T1-T2-T3	4.71^{b}	3.62^{ab}	2.88^{a}	30.29
	T2-T2-T1	4.22^{ab}	3.04^{a}	2.69^{a}	30.45
	Mean	4.80	3.40	2.89	30.63

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME
^{a,b,c} within columns differ significantly.

Figure for economic analyses as calculated by benefit-cost analyses, excluding the feather yield is shown in Table 8. High nutrient density at finisher phase, as in the case of T1-T2-T3, although gave highest bodyweight yet caused negative profit, as the price of T3 diet was 1,5 times of the T1. Highest profit was obtained from T1-T2-T2 treatments for both, irrespective of the water pond availability. The feather yield was not included in the analyses because the authors unable to get information on the price of each fractions. Usually feather is marketed in Indonesia as a 'bulk' without fractionated and most of the quality feather was blown away during traditional sun drying process.

In conclusion, the presence of water pond did not improve growth nor improve feather yield and quality. For growth performance, higher density diet is better fed at grower and finisher phase, indicating a possible compensatory growth to occur. Low-density diet at finisher phase produced poorer growth. However, for cost-benefit analysis, low and moderate density of diet, such as T1-T2-T2, is better used. Low density diet also yielded low production of feather, but more results were obtained when the animals are raised without water pond facility.

Table 8. Benefit-cost analyses of duck raised in the pens with or without water pond and fed various dietary treatments (Rp./head)

Pen	Dietary treatments	Cost	Income	Gross Profit
With water pond	T1-T1-T1	10,739	11,092	353
	T1-T2-T2	12,183	13,351	1,168
	T1-T2-T3	14,568	13,320	- 1,248
	T2-T2-T1	10,501	10,956	454
Without water pond	T1-T1-T1	10,888	11,781	893
	T1-T2-T2	11,465	12,629	1,164
	T1-T2-T3	13,239	12,708	- 531
	T2-T2-T1	11,155	12,193	1,038

T1=12%CP/2000 kcal ME, T2=16 %CP/2500 kcal ME, T3= 20%CP/3000 kcal ME

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