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THE EFFECTS OF DIFFERENT PROTEIN AND ENERGY LEVELS ON BROILERS PERFORMANCE UNDER HOT CLIMATIC CONDITIONS

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ABSRACT
The present experiment was designed to evaluate the effect of different protein and energy levels on broilers performance under hot climatic conditions. A total of three hundred Ross-308 chicks were selected on basis of uniform starting live bodyweight (45g/chick) proximately. Chicks were randomly divided into three treatments with five groups of 20 chicks per pen. Diets were formulated based on white sorghum, groundnut meal and sesame meal bone meal to meet the nutrient requirements of broiler diet. Test diets were fed in mash form, three forms of diets were used 19.7% (NRC 1999 Kuku Animals Centre) recommended with 3200 Kcal / kg as reference, 21% and 23% CP supplied with 3100, 3000, Kcal/kg a proximately of ME respectively. Performance, body weight, feed intake, feed conversion, mortality and economical profile were determined. The results with level of high protein improved, body weight, weight gain, and feed conversion significantly ($P<0.05$) with the being high in the treatment groups for body weight gain (1668.5±31), mean value of hot carcass weights (1681.3±108.2) and cold carcass weights (1662.5±197.8). Feed intake scores significantly ($P<0.05$) improved when raised protein levels; Profitability ratios of test groups were high, with recording the value (56.87%) with being high in treatment groups and the lower was (41.74). The results of the present work indicate that a protein level of 23% and energy level of 3000 kcal/kg diet may be recommended for broiler chicks raised in hot climate, protein level of 20% and energy level of 3200 kcal/kg diet may be recommended for finishing broiler chickens.
Keywords: Hot Climatic, body gain, Carcass weights, Profitability ratio

INTRODUCTION
Chickens, like all homoeothermic animals, maintain a constant body temperature over a wide range of ambient temperatures. However, when the physiological and behavioral responses to high ambient temperatures are inadequate, an elevation in body temperature occurs, causing a decrease in appetite, growth rate, and productivity, high ambient temperature has been a major factor hindering production of poultry meat in hot climates, especially in developing countries where farmers cannot afford costly artificial control of ambient temperature in broiler houses (Yalçin *et al.,* 1997; Deeb and Cahaner 2001). Growth rate and meat yield of contemporary commercial broilers is substantially depressed by the environmental stress caused by high ambient temperature. The reduction in feed intake at high ambient temperatures usually makes caloric energy the limiting nutrient Geraert *et al.* (1992). The large discrepancies observed in the effect of high temperature on ME values may be the consequence of opposite changes. A decrease in feed passage rate (up to 17%) due to increased ambient temperature has been reported in 7-wk-old ducks. This will require a careful appraisal of the relative importance of different nutritional relationships to the overall assessment of dietary nutrient specifications. Olomu and Offiong (1980) found that a protein level of 23% and energy level of 2800 to 3000 kcal/kg diet may be recommended for starting broiler chicks raised in hot climate. McDougald and Mc Quistion (1980) and Dale (1985) suggested that increase dietary protein at high ambient temperature is not beneficial to broilers, during summer months. Holm and Fletcher (1997) reported that high temperature holding just prior to slaughter may negatively affect broiler breast meat quality. Zulkifli *et al.,* (1999) found that red jungle fowl had higher serum glucose level than commercial broilers, and the trait was not affected by heat exposure .Waldroup, *et al.,* (2005) showed that the reduction of (CP)

level in starter diets had a significant influence on the live performance. Bonnet *et al.* (1997) revealed that birds exposed to high ambient temperatures divert part of their production energy to maintain thermal homeostasis, and manifest physiological responses such as panting. A decrease in feed intake and growth has been reported in association with reduced feed efficiency. Cooper and Washburn (1998) reported that over the 28- to 49-day experimental period, heat stress of 32 °C resulted in a 35% decrease in gain. Sharifi *et al.*, (2010) also observed that high ambient temperature is a major factor for diminishing reproductive performance of broiler parent stocks. Swennen *et al.,* (2004) noted that energy deposition is the net result of energy intake and expenditure and is controlled by multiple regulatory mechanisms. Next to genetic factors, exogenous factors such as environmental conditions and nutritional factors (e.g., diet quantity and composition) interact strongly with the control and regulation of the energy flow.

The present study was conducted to evaluate the CP requirements of broilers grown to 42 days, utilizing different Levels of Protein and Energy on broilers performance under hot climatic conditions

MATERIAL AND METHODS

Housing: The building used for the study was an open-sided poultry house containing 3 identical rooms 5.20 × 4.20 × 2.75 m dimensions. Each room was divided into two equal pens using wire mesh. Each pen was supplied with a trough feeder and plastic drinker. Artificial light during the night was used 18.00 PM to 06.00AM. Light was provided approximately 24 hours/day. Four bulbs (60 watt) lamps were used for this purpose. The pen dimensions were (2 m long × 1 m wide × 40 cm height). Daily ambient temperatures were measured and relative humidity determined by means of a wet and dry bulb thermometer, the experiments were conducted during summer season (June-July).

Broiler Management

The experiment was conducted on a commercial research farm. A total of 300 un-sex 1-d-old broiler chicks of a commercial strain Ross 308 were bought from Coral Farms for Rations and Poultry production Khartoum, Sudan, and placed on new deep litter, and curtain-sided.

Feed Formulation

A sorghum cereal and sesame, ground nut meal diet was formulated to meet the nutrient requirements according to Central Animal Nutrition Research Laboratory Animal Production Research Centre, Kuku (Sudan). The control treatment was of 19.7% CP with 3200 kcal /kg. Two other diets were formulated to be approximately 21% and 23% CP with 3100 kcal /kg and 3000 kcal /kg respectively, In (Table 1). The metabolizable energy levels were calculated using the individual metabolizable energy values of the ingredients as outlined by (NRC 1999 Kuku) nutrient requirements for broiler chicks.

Data Collection

Broiler performance and mortality were monitored during the production trial to determine the effect of nutrient density. Body weight and feed intake per pen were assessed. Feed conversion ratio (feed: gain) was assessed during these periods and was corrected for mortality.

Slaughter and Carcass Measurements:

All birds were slaughtered at the end of the experiment and dressed and an hour after the birds weighted. Carcasses were chilled overnight at +4 ^{o} C and weighed.

Economics

Sensitivity analysis was conducted to determine gross feeding margin based on carcass and meat weight. Sensitivity analysis can be defined as the process of evaluating the effect on the output from a model of changes in key variables (over a reasonable range). The sensitivity analysis allowed determination of gross feeding margin for a given period as influenced by dietary treatments. Diet costs were considered the base price. Base diet costs were estimated on AlFashir town ingredient prices as of July 2011. Base meat prices were 15SDG/kg (Sudanese Gineh), to represent carcass. Gross feeding margin per bird was calculated as output value (meat price × meat weight) minus input cost (feed cost = diet cost × feed consumption)

Experimental Design and Data Analysis

The experiment was conducted using a completely random design (CRD) Steel and Torrie (1980) with five replication of each treatment. Data were analysis using analysis of variance (ANOVA) (SAS Institute, Inc. 1993). When treatment effect was detected; differences between treatments were identified using least significant design (LSD) (Freud and Wilson 1997). For all comparisons, values *P*<0.05 were accepted as the critical levels of significance. The primary objective of the study was to determine the effect of different dietary protein and energy levels on broiler chick's performance under hot Climatic conditions in (AlFashir) Sudan.

RESULT AND DISCUISSION

The analyzed values for both different dietary protein and energy levels results of feed intake, weight gain and efficiency feed conversion of broiler chicks were shown in Table 2. Test groups mean values for initial weight are similar (P> 0.05) in both. Test group mean values for live body weight (BW), body gain (BG), feed intake (FI) were improved as the protein level was increased stepwise from 19.7 to 23% significantly (P>0.05).

Feed intake (FI): feed intake records on protein and energy fed to broilers at different levels indicated clearly that the use of (23%CP) had improved performance significantly better than those obtained on the lower protein levels tested (P < 0.05; Table2). This agrees with findings by Yalçin (1997) documented that it's possible that broilers under summer heat exposure counteract their increasing body temperature by reducing feed intake. Squibb *et al.,* (1959) concluded that the greatest proportion of economic loss associated with heat stress is the result of lowered feed intake. However efforts to increase feed consumption during heat stress by force have been shown to decrease survival. Ojano-Dirain and Waldroup (2002) studied that to increase protein/amino acid levels to account for reduced feed intake. Ziad (2006) reported that high ambient temperature has a significant effect on reduction in feed intake of heat exposed broilers. Yalçin *et al.*, (1997) exhibited that commercial broiler differed significantly in body weight gain 4-7 wks in the summer's high ambient temperature. Dozier *et al.* (2007) suggested that broilers fed less dense amino acid diets had the ability to increase feed consumption, which in turn increased abdominal fat yield. Hassanein (2006) Chicks fed on low P diet consumed significantly lower feed than those fed on low energy or control diets at different age intervals from 4 up to 7 weeks of age, were no significant differences in the feed intake of broilers from different groups at 4 and 5 wk of age; however, at 6 and 7 wk of age, birds from the 28–22°C and 34°C groups consumed an average of 18 and 41 g/bird per day less feed.

Weight gain: Weight gain in experiment was affected by dietary protein (Table 2). However, the effect of dietary protein, and energy levels were significant(p<0.05) The energy and dietary protein levels for broilers occurs because the broilers fed 19.7% CP diets gain slightly more weight and have a higher feed conversion compared to broilers fed the 23% diet. The broilers fed the 21% protein diet also had a higher feed conversion. Broilers fed the 23% CP diet showed a deleterious effect. This agrees with Aksit *et al.,* (2006) documented that heat-stressed broilers at 34°C had 2.6, - 19.9% lighter body weight at 4 - 7 week of age. Babu *et al.,* (1986) found that live weight were significantly greater with 24 and 22% protein than 20%. During hot-humid season higher dietary level of protein become harmful for broiler and bird suffered. Magabshushanam (1978) documented, diets with 22.5% gave greater weight gain in summer. (Waldroup *et al.*, 2005 and Khajali *et al.*, 2010) founded that decreasing (CP) levels lower than 22% significantly decreased body weight gain .Shan et al., (2003) showed that, as expected, chicks raised at 35°C consumed less feed and gained less body weight compared to those kept at 25°C. The feed: conversion ratio of chicks kept at 35°C was slightly higher (P < 0.05) than those at 25°C (1.49 versus 1.48). Borges *et al.,* (2003) showed that heavier broilers (approaching market age) are sensitive to high-temperature challenges. This sensitivity can be explained by the fact that broilers have greater difficulty keeping thermal homeostasis due to the larger body mass and high rate of metabolism associated with rapid growth. Sandercock *et al.,* (2001) reported that the extent of the hyperthermia was much greater in the older birds and as such was most likely attributable to relative differences in the birds' body sizes, surface areas, and geometries and the effects these differences have upon subsequent heat exchange. Quentin *et al.* (2005) an essential amino acids level in the feed higher than 115% of NRC specifications might be needed to achieve optimal growth, feed conversion, and body composition in male broilers from 21 to 42 d of age. Nagaraj *et al.* (2007) Protein level had a significant (P < 0.05) effect on body weight on 14, 29, and 43 d of age. At 43 and 54 d of age, BW was significantly influenced by protein source and sex. Thim *et al.,* (1997b) there appears to be no advantage in attempting to overcome the effects of heat stress through increased protein or amino acid levels. Such practices with broilers from 3 to 6 wk of age might lead to even more deleterious results

feed conversion (FC): The statistical analysis of feed conversion improved significantly($P>0.05$) with increase in protein levels up to 23% The trend of improving weight gains and feed efficiency with increasing dietary protein up to 23% for broiler chicks is in agreement with findings by (Olomu, 1976). Similar improvement in weights and feed efficiency as the dietary protein level increased from 14% to 24%. Better FCR was observed in birds fed diet containing 23% protein dietary but statistically not different from those fed diet containing 21% protein dietary, results were in agreement with those of Magabshushanam (1978) suggested that feed efficiency was best on 24% protein with ratio from 94 to 105:1 kcal/kg ME. Geraert *et al.* (1992) founded that feed efficiency improved with increase in dietary energy levels although the differences in feed efficiency between any two consecutive groups were not significant. Feed cost tended to increase none significantly with increase in energy level. Deschepper and DeGroot (1995) stated that the performance of chicks was significantly influenced by the dietary protein regime. Olomu(1980)reported that the feed efficiency at the higher energy level (3200 kcal/kg diet) was significantly better than that at the lower energy level (2800 kcal/kg diet) but not significantly better than that at the medium energy level (3000 kcal/kg diet). Ojano-Dirain and Waldroup (2002) studied that improving overall balance of the diet by amino acid supplementation appears to be more effective than increasing total protein intake. Mendes *et al.,* (1997) reported that feed conversion was significantly ($P \leq 0.05$) higher in cold and hot cyclic temperatures than in thermoneutral conditions. Kidd *et al.,* (2004) documented that feeding broilers moderate amino acid density resulted in good corrected feed conversion, but higher amino acid density diets was needed to optimize final broiler weight and breast meat yield. Wiernusz, and Teeter (1993) predicted that feed efficiency was best with the birds providing 22-24% CP; these results suggest that feedback effects of surface temperature on core temperature also exist in poultry as already. An increase in the protein intake subsequently increased performance of the chickens in relation to increased protein content of the breast, drumstick and thigh meat. (Kubena *et al.,* 1972 and Hacina *et al.,* 1996) studied the effect of two ambient temperatures, hot (32 °C) and normal (22 °C) on the performance of *ad libitum* fed and pair-fed broilers. Growth rate of heat exposed broilers (32°C *ad libitum*) and pair-fed birds (22°C pair-fed) was significantly ($p<0.05$) depressed by 30% and 20%, respectively, to low levels complemented with specific amino acid. Temim *et al.,* (2000) documented that increased dietary protein content clearly improved growth performance and carcass characteristics. Dozier *et al.* (2008) broilers consuming less feed per unit of gain have led to formulating higher amino acid density diets in commercial production for improved performance and meat yield. Olomu (1976) revealed that there is an optimum energy concentration in a ration beyond which performance of chicks does not appear to improve and, in some cases, actually deteriorates. Berres *et al.,* (2010)reduced performance is eventually observed when broilers are fed low-protein diets, even when industrial amino acids are provided to reach requirement levels. The reason for this detrimental effect has not been precisely determined, but it is possible that nonessential amino acids become limiting below a certain level of protein in the diet. Thim *et al.,* (1997b) increasing dietary CP levels above 20% to provide > 100% NRC amino acid levels in a corn-soy diet produced deleterious effects on feed conversion and body fat deposition at temperatures above 29.4"C.

Metabolizable energy: dietary energy levels did put forth significant effects on weight gain, feed consumption feed efficiency at the 21 and 23% protein levels similarly each other but were significantly better than those obtained on the lower protein levels, this in agreement with previous findings by Thim *et al.,* (1997b) the dietary energy levels used by these researchers varied with each trial; however, the energy levels utilized for the heat stress broiler trial were 3080 kcal ME kg in the starter diet and 3190 kcal ME kg in the finisher diet. The optimum heat stress diet utilized during the. Dozier *et al.* (2008) founded that chicks fed diets formulated to 3,140 kcal of AME_n/kg had improved 0- to 15-d feed conversion when subjected to suboptimal brooding temperatures compared with a diet formulated to 3,040 kcal of AME_n/kg, but cumulative growth responses were similar between dietary treatments, but these finding disagreement by Thim *et al.* (1997a)documented that broilers fed the higher energy diets containing 3250 kcal ME/kg instead of the 3000 kcal ME/kg were able to consume similar intakes of dietary energy expressed as ME across all environmental temperatures. Geraert *et al.* (1992) reported that hot climatic conditions significantly increased AME and TME values, particularly in leaner birds. Protein retention efficiency was enhanced by selection for leanness and increased with ambient temperature. (Waldroup *et* al., 2005; Khajali *et al.* 2010) founded that decreasing (CP) levels lower than 22% significantly increased the feed conversion ratio (FCR). Swennen *et al.,* (2004) indicated that isoenergetic substitution of fat for protein has a strong effect on growth and on energy and protein balance in broilers. The theory linking diet-induced thermogenesis to feed intake could not be corroborated or countered, and further research is warranted.

Hassanein (2006) Feed conversion of chicks fed on low P or low E diets tend to be better than those fed on control diet, but the effect of level of protein or energy on carcass traits was not significant. Kassim and Suwanpradit (1996) reported that the Chicken were not able to adjust their energy intake exactly but tend to over consume more energy in process of meeting the protein requirement for the tissue built up. Thim *et al.,* (1997b) suggested that the minimum dietary protein levels created an advantage for broilers reared in heat stressed conditions and significantly improved efficiency of protein and calorie utilization. Latshaw (2008) the results suggest that the diet composition and form have a significant effect on the energy intake of broiler chickens. Swennen *et al.,* (2004) the overconsumption of energy compared with protein energy leads to a combination of increased fat accretion and increased heat production

Slaughter and carcass measurements: The statistical analysis showed significantly difference ($p<0.05$) in Slaughter and carcass measurements in birds fed diets containing varying levels of protein dietary shown in Table 3. Better slaughter and carcass measurements was observed in birds fed diet containing 23% protein dietary, Mean slaughter weight of the test group (1713.5 ±6.79) was significantly ($p<0.05$) higher than the lower protein dietary. Test group mean values in remaining parameters hot carcass weight, cold carcass weight, shrinkage %, cold dressing%, hot dressing%, total edible part% were higher ($p>0.05$) than the lower protein dietary. These results were agreed by Servet *et al.,* (1997) exhibited that commercial broilers reared at 34°C exhibited a significant decrease in carcass and breast yield. The slaughter and carcass measurements at the 21 and 23% protein levels did not differ significantly from each other but were significantly better than those obtained on the lower protein levels, at the highest energy level (3200 kcal/kg diet) was improved carcass measurement, but not significantly better than that at the lower energy levels (3000- 3100 kcal/kg diet),

Mortality: Mortality was low (< 0.5%) and was not significantly different among treatment groups. Also, some of the mortality was not related to treatment effect.

***Economics profile*:** Poultry production is of a short cycle, with good profitability that makes it successful as an industry. Supplementation of protein and energy different levels improved the performance of broiler chicks and resulted economical benefits, were shown in Table 4 the study indicates an obvious advantage of the ration containing 3000 kcal/kg diet over other rations in terms of at least weight gain and feed cost per kilogram of live weight gain. No promote improvement in feed efficiency was obtained when the energy level was increased from 3000 to 3200 kcal/kg diet in reference group (SDG 4.56) and higher in fed group (SDG 3.24 and 3.22), this might be due to the adverse effect of protein dietary in the treatment group. The higher cost of feeding per kg live weight gain might be due to lower overall performance by the protein dietary fed group. Addition of protein dietary in the diets of different treatment groups at three dietary proteins had shown an improvement in the cost of feeding, which might be due to the reversal effect of protein dietary against low protein dietary. The cost difference over reference group was lowest in the group fed medium protein dietary, followed by the low and high protein dietary Dozier *et al.* (2007) documented that feeding high amino acid density diets to broilers increased gross feeding margin. The total selling values of meat is the total income obtained. Profitability ratios of all test groups were higher than the lower group (56.87%), (50.35%), and (41.74%) respectively. Choice of protein and energy inclusion level to attain maximum profitability depends on relative current prices.

Table 1. Composition of rations used in experiments

Items	Rations (%)		
	1	2	3
White Sorghum (Fetarita)%	62.1	63.7	68.0
Groundnut cake%	17.00	14.10	11.0
Sesame cake%	16.10	14.10	11.0
Broiler concentrate (LNB)1 %	5.00	5.00	5.00
Bone meal%	1.90	1.50	1.50
Salt%(NaCl)	0.12	0.120	0.250
Vitamin and mineral premix2	++	++	0.020
Oyster shell	-	-	4.228
Wheat bran	-	-	3.50
Total	100	100	100
Calculated chemical composition			
ME Kcal/kg	3000	3100	3200
CP%	23.00	21.00	19.70
Lysine%	1.25	1.25	0.025
Methionine%	0.50	0.50	0.50
Ca%	1.60	1.22	0.931
Av (P) %	0.48	0.47	0.30
Ether extract%	3.20	3.40	3.50
Crude fiber%	12.50	12.60	12.20
Ash%	4.00	4.08	4.10
Protein: calorie ratio	1:122	1:134	1:144

1- Commercial concentrated 2100kCal/kg metabolic energy; Crude Protein 40%; Crude Fiber 2%; Calcium 10%; Phosphorus 4%; Lysine 12%; Methonine 3%

2-Guaranteed levels of vitamin and minerals supplements per kg product: vit. A: 300.000 UI; vit. D3: 100.00 UI; vit. 4.00mg; vit K: 98 mg; vit. B2: 1.320MG; vit. B12: 4.000mg; pantothenate: 2.000mg; niacine: 20.000mg; folic acid: 100 mg; choline: 50.000 mg; Copper: 15.000 mg; idoine: 250mg; selenium: 50 mg; manganèse: 24.000mg; zinc: 20.000 mg; Iron: 10.000mg; coccidie: 25.000mg; antioxydant; 125mg and vehicle q.s.p: 1.000g.

Table (2) Analysis of variance for feed intake, weight gain and efficiency feed conversion of broiler chicks as affected by varying levels of protein for42days.

wks	Feed intake(FI) (g/bird/week)			Live body wt (g)			Average weight gain (g)			Feed conversion = weight gain / total feed intake			Feed cost/kg live wt gain(G)		
	Mean± standard deviation														
	Crude Protein%														
	23	21	19.7	23	21	19.7	23	21	19.7	23	21	19.7	23	21	19.7
	3000 Kcal	3100 Kcal	3200 Kcal	3000Kcal	3100Kcal	3200Kcal	3000Kcal	3100Kcal	3200 Kcal	3000Kcal	3100Kcal	3200Kcal	3000Kcal	3100Kcal	3200Kcal
1	146.27	143.88	130.56	118.5	117.3	112.3	73.5	72.3	67.3	1.99	1.99	1.94	0.26	0.25	0.242
2	283.92	329.58	260.29	253.7	273.5	234.5	135.5	156.2	122.2	2.10	2.11	2.13	0.647	0.792	0.736
3	579.44	613.80	604.35	519.5	552.5	503.1	265.8	279.0	268.6	2.18	2.20	2.25	1.163	1.366	1.300
4	832.92	546.78	637.18	898.1	789.2	775.4	378.6	236.7	272.3	2.20	2.31	2.34	1.969	2.158	2.420
5	1022.09	1079.4	999.9	1358.5	1258.5	1200.9	460.4	469.3	425.5	2.22	2.30	2.35	2.957	3.631	3.419
6	905.25	995.54	661.51	1713.5	1641.4	1445.9	355.0	382.9	245.0	2.55	2.60	2.70	3.985	3.998	4.090

Means in the same row bearing different superscripts differ significantly ($p<0.05$).2.7

Table 3. Analyses of variance and average (mean ± st.dev) slaughter and carcass values of broiler Chicks as affected by varying levels of protein for42days.

Items	Mean± standard deviation			
	F[ψ]	Crude Protein%		
		23	21	19.7
Slaughter weight (g)	0.00	1713.5 ^{a} ±6.79	1641.10 ^{b} ±6.80	1412^{c}±7.09
Hot carcass wt (g)	1194.43	1681.3 ^{a} ±383.5	1605.8 ^{b} ±108.2	1400.57^{c} ±51.04
Cold carcass wt (g)		1662.5 ^{a} ±197.8	1586.4 ^{b} ± 197.8	1379.57^{c} ±72.63
Shrinkage %	102.58	1.13 ^{b} ±0.30	1.23 ^{a} ±0.20	1.23^{a} ±0.04
Cold dressing%	127.25	70.27 ^{a} ±1.34	69.49 ^{b} ±0.51	69.85^{a} ±7.46
Hot dressing%	5.65	69.39 ^{a} ±1.20	68.88 ^{c} ±0.47	69.15^{b} ±0.67
Total edible part%	6.10	71.18 ^{a} ±5.68	69.20 ^{b} ±2.37	67.55^{c} ±0.13

Means in the same row bearing different superscripts differ significantly (p<0.05).

Table 4. Major inputs and margin over major inputs (per head) of broiler chicks fed as affected by varying levels of protein for42days.

Items	cost of production		
	Crude Protein%		
	23	21	19.7
Meat sales (SDG)*	25.46	24.55	21.18
Chick purchase (SDG	2.85	2.85	2.85
Feed cost (SDG) **	3.24	3.22	4.56
Major cost of production	10.98	12.19	12.34
Feed cost per kg live weight	1.89	1.90	2.76
Margin over major inputs	5.81	5.79	4.47
Profitability (%)	56.87	50.35	41.74
Profitability ratio	14.48	12.36	8.84

*At current (July 2011) prices of meat 15 SDG/ kg.
**At current (July 2011) price of mash 42.1596 SDG/ kg

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