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Bibliography. Figures. Tables.


Jammal, B.

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EFFECT OF REPLACING FISH MEAL TOTALLY AND PARTIALLY WITH VEGETABLE SOURCES ON BROILERS PERFORMANCE

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ABSTRACT

An experiment was conducted during October-November 2003 at Amchit in a experimental farm to evaluate the effect of replacing fishmeal (FM) with soybean (SB) on mortality, live body weight, growth, food intake, food conversion ratio and meat taste. One hundred eighty broiler chicks of one day old were used and randomly distributed into six groups each one receiving a different ration scheme. The rations treatments used were: control-groups A and B- 5 % FM (Indoor and outdoor respectively); group C and D- 0 % FM (Indoor and outdoor respectively) group E and F- 1 % FM (Indoor and outdoor respectively). Broilers were fed ad libitum. The feedstuff given to broilers was divided into two feeding periods, starter (0-28 days) and finisher (29 till slaughter). Data obtained on live body weight at 10, 20, 30 and 37 days of age showed no significant difference (P>0.05) between treatments. However, a significant difference appeared between housing environments. Group C and D, receiving 0 % fishmeal, presented at the end of the experiment the highest average in live body weight (indoor, 1851.9 ± 144.6g and outdoor 1515.2 ± 153.7g, respectively). In the same manner, group C presented the highest weight gain (+ 2.6 %) related to control group A. A lack of mortality (0 %) as well as an improvement
in feed intake (-27.4% related to control), feed conversion ratio (2.74 and 3.35, respectively) and meat taste were presented in group C and D. The economical study showed that group D presented the least cost concerning meat production and the feedstuffs (-42.9% related to control group). Based on this results, ration 0% FM used in groups C and D, gave us the best results.

RÉSUMÉ

Une expérience a été menée durant les mois d’octobre et de novembre 2003 dans une ferme expérimentale à Amchit afin d’évaluer l’effet de remplacement de la farine du poisson partiellement ou totalement par le soja sur le poids des poulets de chair, le gain de poids, la mortalité, la consommation de nourriture et son taux de conversion ainsi que son effet sur le goût de la viande. Dans ce but, cent quatre-vingts douze poussins âgés d’un jour ont été répartis au hasard en 6 groupes recevant chacun une ration différente. Les systèmes utilisés sont : témoin - groupes A intensif et B- extensif : 5% farine de poisson -groupes C intensif et D- extensif: 0% farine de poisson –groupes E intensif et F- extensif : 1% farine de poisson. L’alimentation des poulets a été divisée en 2 phases principales : début (les 4 premières semaines) et fin (le reste jusqu’à l’abattage. Les résultats obtenus sur le poids au 10ème, 20ème, 30ème et 37ème jours d’âge n’ont montré aucune différence significative (P>0,05) entre les traitements. Par contre, on a remarqué une différence significative selon les différents environnements d’élevage. A l’abattage les groupes C et D, recevant 0% farine de poisson, ont présenté les poids les plus élevés (intensif : 1851,9 ± 144,6 g et extensif 1515,2 ± 153,7 g, respectivement). D’autant plus, le groupe C a montré un gain de poids significatif (+ 2,6%) supérieur à celui du groupe témoin A. L’absence de la mortalité (0%), la consommation (-27,4%) apparenté aux groupes témoins et le taux de conversion de nourriture (2,74 et 3,35, respectivement) et un goût de viande ont été remarqués chez les groupes C et D. L’étude économique faite a montré que le groupe D, comparé au groupe témoin, présente des coûts de productions de la viande et de la production alimentaire, relativement moins chers. D’après tous ces résultats, on peut déclarer que le système de ration 0% farine de poisson utilisé dans les groupe C et D est le meilleur et nous recommandons qu’il soit utilisé.

INTRODUCTION

The poultry industry received considerable criticism on welfare grounds regarding the alimentary practices it operates, particularly relating to using
fishmeal (animal sources) and replacing it by vegetables with high protein content. Fishmeal is a high protein feedstuff often included in poultry diets. It is usually marketed at 65% crude protein, but the crude protein content can vary from 57 to 77%, depending on the species of fish used. But today, all consumers demand a healthy food free of animal sources specially after madcow disease that is why the research included outdoor groups rearing (Perez-Maldonado, 1999). Early in this century, chemists recognized that SB seed is a rich source of protein and oil (approximately 40% and 20% respectively; Detlef, 1994). The economic importance of this discovery shifted SB cultivation from forage to seed production. Today 70 million hectares of SB are grown worldwide and production now accounts for about 30% of the world’s vegetable oil market, along with the production of high protein meal for poultry and other intensive livestock (NOPA Yearbook, 1997).

A problem facing fishmeal is that it is usually contaminated with sand and peroxidizes very quickly resulting in appearance of toxic free radicals, which lower energy value. Oxidation may also cause self-heat of the product during storage that reduces amino acids digestibility such as gizzerosine and histamine, which are formed during processing of fishmeal (Abraham et al., 1971). Those substances reduce growth rate in broilers. Fish meal contains above normal amount of NaCl exceeding 4%, and also might be contaminated with *Salmonella* and *Clostridia*. All these factors may result in decreased flock liveability and may affect the health of consumers (Smith and Associates, 1997).

Some researchers affirm that there is no difference on broiler performance if fishmeal is replaced, therefore some others like Webster and Coworkers (2000) suggested that fishmeal could result in increasing the percentage of mortality. Hossain et al. (2004) confirmed as well that replacing fishmeal in rations induce better liveability by 8% approximately. On the contrary, Miles and Jacob (1997), Pike (1999) and Shen (2001), suggested that lower mortality is obtained when using rations containing fishmeal.

About outside housing, surrounded by high temperature, the chicks may loose weight during transpiration while with low T°C energy is usually used for heating (Krogh, 2000).

The principal idea was to find a partial or total replacement to the fishmeal (animal source) with soybean meal (vegetable sources) in broilers-chicks rations because it is superior in amino acids and energy contribution from all other ingredients of plant origin. The objective of our study is to change ingredients composition of the rations after studying the physiological parameters that affect body performance of broiler-chicks housed inside and outside as well a formulate least-cost price can be found.
MATERIALS AND METHODS

1. Animals and husbandry

One hundred ninety two day-old broiler chicks (Cobb x Cobb) were floor reared on wood shavings, in closed windowless and well-ventilated pens. The chicks were divided equally and randomly distributed into six pens, each one receiving a specific ration program. The rations given to the chicks were as follow: Ration 5 % FM- A indoor and B outdoor (divided into two periods: starter 4 weeks and finisher to slaughter). Ration 0 % FM- C and D Ration 1 % FME and F.

The chicks were vaccinated for Gumboro disease at 10 and 15 days of age and for Infectious Bronchitis and Newcastle at 18 days of age. Heat was provided to the chicks by artificial gas brooders placed at 90 cm above the floor to indoor groups and natural for outdoor groups. Birds were provided rations based on FM / Soybean mixture. Food and water were given ad libitum through all the experiment. A broiler starter ration (24% CP, 3060 Kcal/Kg ME), usually a crumb, was fed to an age of 28 days. Thereafter, finisher period (20% CP, 3090 Kcal/Kg ME) was used from day 28 till slaughter.

2. Taste panel test

After 38 days from the beginning of the experiment, the broilers were weighed and slaughtered and 4 broilers from each group were randomly chosen and submitted to taste panel analysis, where it was scored at 3 unit score (1 = good, 2 = acceptable and 3 = refused).

3. Data collection

Temperature and relative humidity were measured 4 times per day, in the morning, at noon, afternoon and at midnight and using dry and wet thermometers. Mortality was recorded daily. Live body weight and feed intake were measured at 10, 20, 30 and 37 days of age. Weight gains and feed conversion ratio were calculated at 10, 20, 30 and 37 days of age.

4. Data analysis

For statistical analysis, one-way analysis of variance (ANOVA) was conducted using “Sigmastat software” to evaluate differences between treatment means. Probability levels (P) equal to or less than 0.05 were considered signifi-
cant in all tables, while correlation between means was consistent at (*) $P<0.05$, (**) $P<0.01$ and (***) $P<0.001$. Results in tables are illustrated as means $(X)$ ± standard deviation (SD).

5. Diets composition

Tables 1 and 2 show that three rations were prepared with different ingredient and nutrient composition depending on chicks’ age-starter (0 to 28 days) and finisher (29 to 38 days of age) rations as recommended by NRC (1994).

Diets were formulated using special computer softwares: Degussa, Jammal & Awada, and Tora programs.

**Table 1:** Ingredients composition (g %) and nutritional content (CP % and kcal/kg ME) of starter (0 to 28 days of age) diets.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Starter diets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control groups</td>
</tr>
<tr>
<td></td>
<td>A and B with 5 % FM</td>
</tr>
<tr>
<td>Corn, yellow</td>
<td>56,0</td>
</tr>
<tr>
<td>Soybean meal, (45,8% CP)</td>
<td>32,3</td>
</tr>
<tr>
<td>Fish meal (70% prot.)</td>
<td>5,0</td>
</tr>
<tr>
<td>Fat, soya oil</td>
<td>2,4</td>
</tr>
<tr>
<td>Alfalfa meal, dehy (18% p)</td>
<td>1,2</td>
</tr>
<tr>
<td>Limestone flour</td>
<td>1,2</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1,0</td>
</tr>
<tr>
<td>NaCl, iodized</td>
<td>0,3</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>0,0</td>
</tr>
<tr>
<td>Premix*</td>
<td>1,0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td><strong>Nutritional content</strong></td>
<td></td>
</tr>
<tr>
<td>Kcal/kg ME</td>
<td>3060</td>
</tr>
<tr>
<td><strong>CP %</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

* Ingredients used in premix composition: Vit. A USPU (millions) 0,3 + Vit. D ICU (millions) 0,1 + Vit. E IU (thousands) 0,1 + Vit. K (menadione), g 0,1 + Riboflavin, B2, g 0,3 + d-pantothenic acid, g 0,5 + Niacin, g 2,2 + Choline, g 21,8 + Vit B12, g 0,3 + Manganese, g 4,4 + Methionine, g 49,6 + Antibiotics, g 5,5 + Coccidiostat.
Control groups A and B were supplemented with 5% FM, C and D 0% and E and F 1% FM. Starter and finisher rations were adjusted with different quantities of SBM and yellow corn replacing FM to maintain the levels of 24% and 20% crude protein (CP) and 3060 kcal/kg and 3122 kcal/kg of metabolizable energy (ME), respectively.

Table 2: Ingredients composition (g %) and nutritional content (CP % and kcal/kg ME) of finisher (29 to 38 days of age) diets.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Control groups A and B with 5 % FM</th>
<th>C and D with 0 % FM</th>
<th>E and F with 1 % FM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, yellow</td>
<td>64.8</td>
<td>58.3</td>
<td>50.5</td>
</tr>
<tr>
<td>Soybean meal, (45.8% CP)</td>
<td>23.0</td>
<td>32.7</td>
<td>29.0</td>
</tr>
<tr>
<td>Fish meal (70% prot.)</td>
<td>5.0</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Fat, soya oil</td>
<td>2.0</td>
<td>4.1</td>
<td>4.5</td>
</tr>
<tr>
<td>Alfalfa meal, dehy (18%p)</td>
<td>2.5</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Limestone flour</td>
<td>1.2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>NaCl, iodized</td>
<td>0.4</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>0.0</td>
<td>0.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Premix*</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Nutritional content</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kcal/kg ME</td>
<td>3122</td>
<td>3122</td>
<td>3122</td>
</tr>
<tr>
<td>CP %</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

* Ingredients used in premix composition: Vit. A USPU (millions) 0.3 + Vit. D ICU (millions) 0.1 + Vit. E IU (thousands) 0.1 + Vit. K (menadione), g 0.1 + Riboflavin, B2, g 0.3 + d-pantothenic acid, g 0.5 + Niacin, g 2.2 + Choline, g 21.8 + Vit B12, g 0.3 + Manganese, g 4.4 + Methionine, g 49.6 + Antibiotics, g 5.5 + Coccidiostats.

Soybean meal and fishmeal used in the study were obtained from local commercial sources containing 46% and 70% CP and 2425 and 2980 kcal/kg ME, respectively.
RESULTS AND DISCUSSION

1. Mortality, health, and livability

Broiler chicks presented good stature, very few leg weaknesses, and showed no health problems or symptoms of diseases or food deficiencies.

Considering mortality, the highest percentage (6.25%) was found in groups A, B, E and F given different levels of FM. No mortality was recorded in groups C and D fed rations with only plant ingredients mainly SBM, where FM was excluded, no matter what type of housing (indoor or outdoor) was used.

During all the experiments, mortality (6.25%) in indoor groups was noticed only in days 9, 21 and 22. It was due to high decrease in temperature (T°C) and increase in relative humidity (%) reaching 20°C and an average of 93.3% respectively. For outdoor groups, we obtained the same percentage of mortality during day 13 and 25 where temperature was 18°C.

Dead chicks were recorded only in groups receiving rations containing fishmeal. These finding agreed with those of Webster and Coworkers (2000) who suggested that fishmeal could result in increasing the percentage of mortality.

In his experiment, Hossain et al. (2004) confirmed that replacing fishmeal in rations induce better liveability by 8% approximately.

Results obtained by Shen (2001), Miles and Jacob (1999) and Pike (1999) were inconsistent with those obtained in our experiment. They suggested that lower mortality is obtained when using rations containing fishmeal.

In order to maintain good health of chicks, Hamid (1968) recommended a well-balanced ration in fishmeal and soybean meal protein. These results were not supported by FAO (1996) and Swick (1998) who agreed with our findings and reported that replacing fishmeal totally by soybean does not have any negative effect on chicks’ health.

2. Live body weight

Data for body weight are shown in table 3. There was not a ration treatment effect (P>0.05) on live body weight of broilers at 20, 30 and 37 days of age in all bird-groups.
Table 3: Variation of live body weight (g) by feeding periods.

<table>
<thead>
<tr>
<th>At the ends of periods</th>
<th>Indoor</th>
<th>Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average weight</td>
<td>Average weight</td>
</tr>
<tr>
<td>Starter</td>
<td>1281,8&lt;sup&gt;a&lt;/sup&gt; ±120,9</td>
<td>100</td>
</tr>
<tr>
<td>Finisher</td>
<td>1817,1&lt;sup&gt;b&lt;/sup&gt; ±120,8</td>
<td>100</td>
</tr>
</tbody>
</table>

<sup>abcd</sup> Means between columns of the same row with different superscripts are significantly different (P<0,05).

*Decrease (-) or increase (+) in weight related to control – group A (as 100%) for indoor & group B (as 100%) for outdoor.

Results obtained (Tab. 3) showed a best body weight at the end of starter period for group C (1291,8 g) fed 0 % fishmeal if compared with control-group A (1281,8 g). Where as for outdoor groups, broiler chicks in F receiving rations with 1 % FM had the best body weight - 1072,5 g with 21,5 % heavier than control (882,6 g) group B fed rations containing 5 % FM.

At finisher period, groups C for indoor and D for outdoor (0 % fishmeal) had the best body weight where they were heavier by 1,91 % and 5,96 % heavier than control groups A and B, respectively.

When comparing live body weight between indoor and outdoor groups, receiving the same rations, heavier body weights were obtained for indoor chicks during all the experiment. It was probably due to the climatic conditions (T<sup>°</sup>C and RH %).
Surrounded by high temperature, the chicks may lose weight during transpiration while with low T°C energy is usually used for heating (Krogh, 2000).

During the first decade, a positive and significant (P<0.05) correlation between temperature (T°C) and body weight was found in outdoor group B (r = 0.639)*.

In the second decade, a positive correlation (P<0.05) between relative humidity and body weight was obtained in outdoor group D (r = 0.69)*, while another correlation (r = 0.76)* between temperature (T°C) and body weight was revealed also in the third decade when controlling for RH.

According to Salado et al. (1999), climatic factors affect live body weight. They suggested that in hot humid climate smaller weights could be obtained because of partial deterioration of soybean containing high percentage of moisture (15%).

The indoor and outdoor groups (C and D) receiving 0% FM rations presented the lowest live body weight during the first two decades. These findings agreed with those of Leske et al. (1991), Liener (1994), Grant (1989) and Salmon (1977) who reported that soybean depresses growth of broilers caused by the presence of oligosaccharides and other anti-nutritional factors.

Later, these groups compensated weight and presented the highest live body weight in the last two decades. Waldroup (1985), Monari et al. (1996), Smith and Associates (1997), Zollitsh et al. (1997), Salado et al. (1998), Ben Abdeljalil (2002), and supported these resulted reporting that soybean is a better source of protein, and more nutritional than fishmeal and is able to increase growth.

At slaughter, the light chicks (1.43 – 1.51 kg) obtained in all outdoor groups were commercially acceptable especially for roasted utilization. Oderkirk (2001) obtained approximately the same results in opposite to what was suggested by Ammazinggraze (2004) and Falsterfam (2004).

3. Weight gain

Table 4 showed that chicks of outdoor groups B and D gained more weight during the finisher period by about 30% if compared to group A.

It was noticed that during the starter period almost all the indoor chicks of all groups had a higher gain rate than those of outdoor groups. These results were switched during the finisher period where the outdoor birds started to gain more.
During the first two decades, groups C and D receiving rations containing 0% FM and full dose soybean meal presented lower weight gain when compared to control groups receiving 5% FM rations. These results agreed with those of Aburto et al. (1998) and Perilla et al. (1997), who reported that soybean showed a depress in average weight gain.

In the third and the last decade, the same groups compensated weight and presented higher weight gain than control.

**Table 4:** Percentage of weight gain per chick by feeding period as related to final weight.

<table>
<thead>
<tr>
<th></th>
<th>Indoor</th>
<th></th>
<th>Outdoor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>C</td>
<td>E</td>
<td>B</td>
</tr>
<tr>
<td><em><em>%</em> +/-</em>*</td>
<td>%* +/-</td>
<td>%* +/-</td>
<td>%* +/-</td>
<td>%* +/-</td>
</tr>
<tr>
<td><strong>Starter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0-28 days)</td>
<td>70.54</td>
<td>100</td>
<td>69.76</td>
<td>-1.1</td>
</tr>
<tr>
<td></td>
<td>72.14</td>
<td></td>
<td>61.72</td>
<td>100</td>
</tr>
<tr>
<td><strong>Finisher</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(29-38 days)</td>
<td>29.46</td>
<td>100</td>
<td>30.24</td>
<td>+2.6</td>
</tr>
<tr>
<td></td>
<td>27.86</td>
<td></td>
<td>38.28</td>
<td>100</td>
</tr>
</tbody>
</table>

Decrease (-) or increase (+) in body weight gain related to control-group A and B considered as 100%

Plamondon (1997) and Pierson et al. (1980) supported these findings while Shen (2001) concluded that soybean does not affect weight gain of broiler chicks.
4. Feed intake (FI) and Feed Conversion Ratio (FCR)

Results obtained and recorded in table 5 showed that the average quantity of feeds consumed per bird per feeding period of groups A, C, and E was slightly different. Broilers of group A (5% FM) consumed at the end of the experiment more concentrates than birds of group C by 27.4% and E by 22.57% receiving rations with 0% and 1% fish meal, respectively. This resulted in different food conversion ratios (FCR) at the end of the experiment where it reached 3.85 (A), 2.74 (C) and 3.07 (E).

If talking about each feeding period it could be observed that food conversion ratio, at the end of the starter period was the lowest for chicks of group C (3.18) and the highest for control group A (4.42).

At the end of the finisher period, group A had the highest (2.42) while group C the lowest 1.75 by 0.67 kg more for making 1 kg of meat than group C.

Food conversion ratio, at the end of the starter period for outdoor groups (Tab. 6) was the highest in group B (6.42) and the lowest in group F (4.08).

At the end of the finisher period, this result was switched making group D (1.72) the best followed by groups F (2.86) and B (2.43).
Table 5: Feed intake (Kg) and food conversion ratio per chick per feeding period for indoor groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>per head (Kg)</th>
<th>Feed intake starter (0 – 28 days)</th>
<th>% +/-</th>
<th>Feed intake finisher (29 – 38 days)</th>
<th>% +/-</th>
<th>Over-all (0-38 days)</th>
<th>% +/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.67</td>
<td>100</td>
<td></td>
<td>1.33</td>
<td>100</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>FCR</td>
<td>4.42</td>
<td>100</td>
<td>2.42</td>
<td>100</td>
<td>3.85</td>
<td>100</td>
</tr>
<tr>
<td>C</td>
<td>4.1</td>
<td>-27.69</td>
<td></td>
<td>0.98</td>
<td>-26.31</td>
<td>5.08</td>
<td>-27.4</td>
</tr>
<tr>
<td></td>
<td>FCR</td>
<td>3.18</td>
<td>-24.28</td>
<td>1.75</td>
<td>-29.41</td>
<td>2.74</td>
<td>-28.83</td>
</tr>
<tr>
<td>E</td>
<td>4.37</td>
<td>-22.92</td>
<td></td>
<td>1.05</td>
<td>-21.05</td>
<td>5.42</td>
<td>-22.57</td>
</tr>
<tr>
<td></td>
<td>FCR</td>
<td>3.43</td>
<td>-22.4</td>
<td>2.13</td>
<td>-14.34</td>
<td>3.07</td>
<td>-20.26</td>
</tr>
</tbody>
</table>
Table 6: Feed intake (Kg) and food conversion ratio per chick per feeding period for outdoor groups.

<table>
<thead>
<tr>
<th>Outdoor</th>
<th>Feed intake starter (0-28 days)</th>
<th>% +/-</th>
<th>Feed intake finisher (29-38 days)</th>
<th>% +/-</th>
<th>Over-all (0-38 days)</th>
<th>% +/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B</td>
<td>per head (Kg)</td>
<td>5.67</td>
<td>1.33</td>
<td>100</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>FCR</td>
<td></td>
<td>6.42</td>
<td>2.43</td>
<td>100</td>
<td>4.9</td>
<td>100</td>
</tr>
<tr>
<td>Group D</td>
<td>per head (Kg)</td>
<td>4.1</td>
<td>-27.69</td>
<td>0.98</td>
<td>-26.31</td>
<td>5.08</td>
</tr>
<tr>
<td>FCR</td>
<td></td>
<td>4.35</td>
<td>1.72</td>
<td>-29.22</td>
<td>3.35</td>
<td>-31.63</td>
</tr>
<tr>
<td>Group F</td>
<td>per head (Kg)</td>
<td>4.37</td>
<td>-22.92</td>
<td>1.05</td>
<td>-21.05</td>
<td>5.42</td>
</tr>
<tr>
<td>FCR</td>
<td></td>
<td>4.08</td>
<td>-36.45</td>
<td>2.86</td>
<td>+17.3</td>
<td>3.76</td>
</tr>
</tbody>
</table>

The over-all conversion of food into broiler-meat at slaughter was the lowest for birds in group B (4.9) and efficiently highest in group D (3.35) saving 31.6% of concentrates per kg of meat.

Comparing the two systems of management, the most efficient FCR at the end of the experiment was obtained in group C (2.74) and E (3.07) housed indoor followed by groups D (3.35) housed outdoor.

Between indoor and outdoor housing, groups C and D receiving 0% FM in rations consumed concentrates less than others consume and presented the best FCR (2.74 and 3.35 respectively) at the end of the experiment. Comparing these results with control groups (A and B), a decrease was obtained in FCR by 28.83% and 31.63% for groups C and D, respectively.
Nazneen (1995) and Hossain et al. (2004) supported our findings when suggesting that fishmeal could be successfully replaced without any bad effect on the FCR and feed intake of broiler chicks.

In an opposite way, Nyrienda et al. (2000) and Shen (2001) and Leske et al. (1991) suggested that replacing fishmeal with soybean meal does not affect FCR in any way.

Sell (1997) agreed with our results concerning feed intake. He confirmed that broiler chicks given rations containing fishmeal present higher feed intake than those receiving rations where fishmeal is replaced.

Aburto et al. (1998), Perilla et al. (1997), Plamondon, (1997), FAO (1996) and FAO (1989), supported these results especially when adding enzymes or other amino acid (choline and lysine) to the soybean ration.

5. Feasibility study

Adjusting the results with the cost-paid for electricity (light) and heating (gaz) used during the experiment, an extra sum of about 0.186 $ / kg of broiler meat produced indoor (A, C and E) and 0.003 $ / kg of broiler meat produced outdoor (B, D and F) were obtained.

Figure 1 shows the final cost-price of 1 kg of broiler-meat produced in both management systems where the highest was in group B (1343 $ / ton) and the lowest in D (773 $ / ton) housed outside having 43 % more profit in comparison with B making a difference of 570 $/ ton.

Our results showed that broiler chicks housed outdoor (group D receiving 0 % FM), presented the lowest price / kg of meat as well as the price of 1 kg of feedstuff.

Shen (2001), Cooper and Benson (1998), Smith and Associates (1997) and Orga et al. (1964) who studied the economical advantages of soybean and its replacement for fishmeal supported our results.

Even when light and heating costs were added, indoor group C receiving also 0 % FM ration presented the same results.
6. Taste panel test

For indoor groups, taste panel test shows that after tasting cooked broiler-meat housed indoor, better results were obtained in groups C (80% no fishy taste vs 20% fishy taste) while broiler meat of A had the lowest score (30% vs 70%).

Opposite results were obtained concerning meaty taste whereas 20% of the scores were “not meaty” and 80% “meaty taste” in groups C and 40% vs 60% in E.

Broiler-meat of group C had more tender taste than any other group housed indoor. The scores of “over-all acceptability” were higher for group C (80%) in comparison with A (50%) and E (60%).

The same results were obtained after tasting cooked broiler-meat housed outdoor where slaughtered birds of group D fed rations containing 0% FM were the best by 90% over-all acceptibility if compared with B (60%) and F (70%) receiving 5% and 1% FM respectively.

If scaling all groups, we can conclude that the results of the taste panel was the best in C and D, no matter what type of management was followed.

Studying the results of the taste panel test, it can be concluded that the best groups were those fed rations without fishmeal no matter what type of management was followed like the results achieved by Falsterfarm (2004) and Ammaringgraize (2004) who housed a commercial flock of broiler chicks outdoor. Oderkirk (2001) confirmed that the best quality broilers for outdoor housing
because of more tender meat than others with, no fishy and no fatty taste opposite to what was obtained by Irish and Balnave (1993) who reported a high level of fat deposit when using rations containing above 25 % soybean meal.

Groups C and D receiving rations with 0 % fishmeal was found to be the most prefered broiler meat.

It can be concluded that total replacement of fish meal with soybean meal give more desirable results than partial substitution as reported by Agbede and Aletor (2003) and Agbede (2000), Nyrienda et al. (2000) and Timmon and Gates (1989) not affecting neither liveability and health nor live body weight, feed intake, growth rate and cooked broiler taste.

**CONCLUSION**

Even though, favorable results were established at the end of this experiment, many other nutritive rations still need to be thoroughly tested in order to find the most suitable ingredient combination for broiler’s health and performance.

Waiting other experiments studying this subject, it can be concluded and recommended the total replacing of the fishmeal by the soybean meal cause of it’s broiler performance and economical benefits.
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