Scientific Paper

Inclusion of cassava root meal in the diet of K-53 Campero chicken

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ABSTRACT: Three hundred male Campero chicken (21 days old) of the K-53 genotype were used, in order to evaluate the effect of the inclusion of cassava (*Manihot esculenta* Crantz) root meal in the concentrate feed, on the productive performance; as well as to evaluate the sanitary stability of the produced feedstuff. The design was completely randomized, with three treatments (0, 20 and 40 % of inclusion of cassava root meal) and five repetitions (represented by pens with 20 Campero chicken each). For the microbiological analysis of the feedstuff samples were taken 14, 28 and 42 days after elaborating the diets. The viability was 100 % in the three treatments; the live weight of the animals at 63 days (1 957, 2 015 and 1 941 g) and the feed intake did not differ among the treatments; however, the inclusion of 20 % cassava root meal significantly improved the feed conversion. Likewise, the inclusion of 20 and 40 % of cassava root meal produced a higher yield in carcass, but there were not significant differences among the treatments in the yield in breast and leg quarters. It was proven that the inclusion of up to 40 % cassava root meal in the concentrate feed affected neither the consumption nor the productive performance of K-53 male Campero chicken; while the diets up to 42 days after being elaborated maintained stability in their sanitary and microbiological indicators.

Key words: performance, concentrate feeds, unskinned carcass yield

INTRODUCTION

Alternative poultry rearing is an effective way to support farmers in the search for food security, and this is of great interest for the developing countries (Fumero *et al*., 2009b). In this sense, alternative poultry production is inserted in the process of generation of technologies and production systems adapted to the local ecosystems and to the specific characteristics of small farmers, which are compatible with the sustainable management of natural resources (Acosta and Betancourt, 2007).

In nutrition, the need of adapting to this new reality has been more intensely imposed. The main reason for that demand is that poultry feeding, in any phase or production purpose, is the one that makes the highest individual contribution to the success or failure of productivity (Acosta, 2009).

The use of local raw materials in animal feeding, in order to substitute inputs and reduce competitiveness with the human feeding, constitutes a challenge for nutritionists and also for small and medium farmers in the search for the feeding solutions destined to monogastric animals (Lon-Wo, 1995).

The high production of starch of the cassava root in tropical countries, as well as the rusticity and great adaptation of this plant to the adverse cultivation conditions, turn it into one of the first alternatives to substitute corn as energy source in animal feeding (Phuc *et al.,* 2000).

In Cuba, the substitution of imported cereals (wheat and corn) in the elaboration of balanced feedstuffs for animals, by national production sources with important contributions of carbohydrates –such as cassava–, has become an important way of substituting imports and saving convertible currency. Therefore, the objective of this research was to evaluate the effect of the inclusion of cassava root meal on the productive performance of K-53 male Campero chicken, and to assess the sanitary stability of the diets up to 42 days after being elaborated.

MATERIALS AND METHODS

The research was conducted under production conditions; for that purpose 300 male Campero chicken, of the K-53 genotype, 21 days old, which were acquired on their first day after hatching at the incubation plant, were used. Until 20 days of age they were fed concentrate feed *ad libitum* for

their category, with a contribution of 22 % of protein and 3 069 Mcal of metabolizable energy (ME) per kilogram of DM. From 21 to 63 days (moment in which the experiment ended), the animals were distributed into three treatments: 0, 20 and 40 % of inclusion of integral cassava root meal (with peel) substituting the import corn, with a contribution of 20 % protein and 3 155 Mcal/kg of ME. The design was completely randomized, with five repetitions per treatment (represented by pens with 20 Campero chicken each).

The concentrate feeds were elaborated according to the requirements and the nutritional contributions of the diets for the growth category (tables 1 and 2). The limits of inclusion of the raw material, as well as the pre-mixture of vitamins and minerals approved by the Unión de Empresas Combinado Avícola Nacional (National Poultry Production Enterprise) (2010) for the production of balanced feedstuffs, and the requirements of the NRC (1994), were taken into account.

The microbiological analyses were made in the Laboratory of Medical Toxicology (TOXIMED) of Santiago de Cuba; the feed samples were taken at 14, 28 and 42 days, according to the established procedures in the Cuban sampling regulations (NC/ISO, 2002; NC/ISO, 2007; NC 569:07, 2007).

At the end of the experiment the productive indicators: live weight (g), daily gain and gross weight gain (g), feed intake (g) and feed conversion (kg) of the chicken, were calculated and determined.

To determine the carcass yield and the yield of the edible portions 10 chicken of each treatment were slaughtered, with a live weight (LW) equivalent to the one the animals had as average at 63 days of age, after a 24-hour fast. The weight of the carcass with neck, as well as the edible viscera (heart, liver and gizzard), the breast, legs and the leg bone was determined individually, to determine their yield with regards to the LW.

The differences among the means were determined through Duncan´s test (1955). For processing the information the computerized system InfoStat was used (Balzarini *et al.,* 2001).

RESULTS AND DISCUSSION

Table 3 shows the results of the productive performance of the Campero chicken, fed with the different diets.

All the animals survived the experiment and there were not significant differences among the treatments in the final live weight at 63 days of the evaluation, or in the weight gain, feed intake, yield in breast and leg quarter.

Regarding the feed conversion, the treatment with 20 % of inclusion of cassava root meal exceeded ($p < 0,01$) the rest of the treatments. The yield in carcass plus neck was higher ($p < 0,05$) in the diets with 20 and 40 % of inclusion with regards to the control. Likewise, highly significant differences were found ($p < 0,001$) in the indicator edible viscera, because the diet with 40 % of inclusion ex-

Table 1. Feed formulas used in the stages of the experiment.

Component (%)	Control	Cassava (20 %)	Cassava (40 %)
Vitamin core	0,15	0,15	0,15
Mineral core	0,15	0,15	0,15
Soybean	34,20	36,64	39,06
Corn	57,52	33,90	10,29
Common salt	0,3	0,30	0,30
Calcium carbonate	1,73	1,62	1,50
Monocalcium phosphate	1,53	1,47	1,42
Soybean oil	3,91	5,28	6,65
DL-methionine	0,22	0,25	0,28
Choline chloride	0,17	0,17	0,17
L-lysine	0,12	0,07	0,03
Cassava meal	0	20,00	40,00
Total	100	100	100

Table 2. Nutritional contribution of the diets.

Indicator	Treatment		
	Control	Cassava (20 %)	Cassava (40 %)
Dry matter (%)	88,0	88,15	88,31
Crude protein (%)	20,0	20,0	20,0
Energy (Mcal/kg)	3 155	3 155	3 155
Crude fiber (%)	2,86	3,15	3,44
Ether extract (%)	6,64	7,32	7,99
Linoleic acid (%)	3,30	3,65	4,0
Total calcium (%)	1,0	1,0	1,0
Total phosphorous (%)	0,70	0,72	0,74
Assimilable phosphorus (%)	0,45	0,45	0,45
L-lysine (%)	1,20	1,20	1,20
DL-methionine (%)	0,53	0,55	0,57
Methionine + cystine (%)	0,85	0,85	0,85
Threonine (%)	0,80	0,79	0,79
Tryptophan (%)	0,24	0,25	0,26

Table 3. Productive performance of the Campero chicken from 21 to 63 days.

Indicator	Cassava root meal (%)			SE ±
	0	20	40	
Viability (%)	100	100	100	-
Initial live weight at 21 days (g/fowl)	419	413	411	5
Live weight at 63 days (g/fowl)	1 957	2 015	1 941	26
Weight gain (g/fowl)	1 539	1 602	1 530	24
Intake (g/fowl)	4 419	4 379	4 465	36
Conversion (kg)	2,87^{b}	2,73^{a}	2,92^{b}	0,03**
Yield in carcass + neck (%)	64,50^{a}	67,66^{b}	64,45^{b}	0,91*
Yield in edible viscera (%)	3,67^{a}	3,61^{a}	4,63^{b}	0,12***
Yield in breast (%)	15,5	16,3	15,6	0,3
Yield in leg quarter (%)	22,1	22,2	22,1	0,3
Yield in leg bone (%)	19,4^{a}	20,8^{a}	21,6^{b}	0,5*

a, b: different letters in the same row differ from $p < 0,05$ (Duncan, 1995)

**: $p < 0,01$, ***: $p < 0,001$

ceeded the rest. The lowest values of the yield in leg bone were found in the control, that differed from the diet with 40 % of inclusion of cassava root meal ($p < 0,05$).

In this experiment better results were obtained than the ones informed by Villa *et al.* (2001) and Fumero *et al.* (2009a) with regarding the standard average live weight of Campero chicken, from 49 to 63 days of age. Also the values of final live weight were higher than the ones reported by Godínez *et al*. (2006) in the lines K-3 and K-5 (1 614 and 1 729 g, respectively), that originate the K-53 Campero chicken. This result demonstrated the hybrid vigor of the K-53 chicken and the possibility of substitut-

ing corn by cassava root meal up to 40 %, which improves the live weight.

The effect of the inclusion of 20 and 40 % of integral cassava root meal in the diets of the Campero chicken is novel, because no studies are reported with such feedstuff in animals of this line. However, in other commercial lines of broilers the cassava meal of good quality has been used in isoenergetic and isoproteic diets, with similar results (Buitrago *et al.,* 2001b; Gil and Buitrago, 2002; Freitas, 2008; Valdivié *et al.,* 2008; Carrijo *et al.,* 2010; Zacarías and Valdivié, 2011; Zacarías *et al.,* 2012).

When the corn was substituted by integral cassava root meal (until 40 %), the feed intake was lower than the one informed by Fumero *et al*. (2009a), Pomar (2011) and Samón (2011), in studies with Cuban K-53 Campero chicken. However, there were not significant differences among the treatments, for which it can be inferred that such substitution in the stage of 21-63 days of age did not affect the intake.

Buitrago *et al*. (2001a), Gil and Buitrago (2002), Valdivié *et al*. (2008), Zacarías and Valdivié (2011) and Zacarías *et al*. (2012) informed that the partial or total substitution of the corn by cassava root meal in commercial broilers did not alter the feed conversion while the diets maintained their isoenergetic and isoproteic conditions. In this study there were significant differences and the best values were obtained in the treatment with 20 % of inclusion of cassava root meal. However, the standard error was low, which indicates that the variations in the measured indicators were minimal. This can be ascribed to the fact that the contribution of vitamins of each diet varied with the inclusion of the cassava root meal, while the amount of vitamin core added remained the same in the three treatments.

The increase of the yield in carcass with the diets of 20 and 40 % of inclusion of cassava meal with regards to the control, as well as the highest yield in leg bone related to the control and to the diet of 20 % of inclusion, economically favored the commercialization of the K-53 Campero chicken, because these high values were obtained with a similar feed intake. This result is due to the best digestibility of the cassava starch with regards to the corn carbohydrates, because it has 70 % of total carbohydrates, which represents 80 % of the non-nitrogenous extract of the cassava root (Gil and Buitrago 2002).

According to Promthong (2005), the broilers which are fed diets that contain cassava meal have a higher population of lactic acid bacteria and yeast, as well as a lower pH in the digestive zone, compared with those that consume corn-rich diets; favoring, to a large extent, the viability, weight gain, feed conversion and yield in carcass.

Table 4 shows the microbiological results of the concentrate feed at different moments of the evaluation. As the days after the elaboration of the diets passed by, the mold count increased in all the treatments, but without exceeding the value of 10^4 –maximum acceptable value for concentrate feeds (NC/ISO, 2007). Likewise, in the samplings conducted the presence of salmonella was not evident. This is an important result if is taken into account that, under the current production conditions in Cuba, the concentrate feeds and raw materials are stored at room temperature; which, along with the high relative humidity, favors the development of fungi and the bacterial growth on these feedstuffs that require conditions of storage in cool and dry places (Martínez *et al*., 2013). Thus, it was demonstrated that the inclusion of up to 40 % of cassava root meal in the feed for fowls does not affect their microbiological quality.

Table 4. Mold and salmonella count in different stages of concentrate feed elaboration.

Treatment	Mold (cfu/g)	Salmonella
Control, 14 days	$5,0 \times 10^4$	Negative
Control, 28 days	$5,3 \times 10^4$	Negative
Control, 42 days	$6,3 \times 10^4$	Negative
Cassava (20 %), 14 days	$5,0 \times 10^4$	Negative
Cassava (20 %), 28 days	$5,0 \times 10^4$	Negative
Cassava (20 %), 42 days	$5,2 \times 10^4$	Negative
Cassava (40 %), 14days	$5,4 \times 10^4$	Negative
Cassava (40 %), 28 days	$5,5 \times 10^4$	Negative
Cassava (40 %), 42 days	$6,4 \times 10^4$	Negative

It is concluded that in male Campero chicken of the K-53 genotype (21 days old) the inclusion of up to 40 % of cassava root meal in the concentrate feeds, to substitute corn, affected neither growth nor yield. There were no alterations in the sanitary indicators of the concentrate feeds elaborated with cassava up to 42 days after being made.

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