

## Effect of Mulberry Foliage (*Morus alba*) Meal on Growth Performance and Edible Portions in Hybrid Chickens

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**Abstract:** This study was conducted to determine the effect of mulberry foliage (*Morus alba*) meal on growth performance and edible portions in hybrid chicken (camperos). A total of 400 birds of 1-day-old were used for 70 days according to a completely randomized design with four treatments, 10 replicates/treatment and 10 birds/replicate. The dietary treatments consisted in diets with inclusion levels of 0, 10, 20 and 30% of mulberry foliage meal. No significant differences ( $p>0.05$ ) were found between treatments for the viability and the sensory quality; however, the inclusion of this feed depressed ( $p<0.05$ ) the body weight at 42 and 70 days, feed intake, feed conversion ratio, weight and yield of the carcass, breast and thigh plus leg compared with the control treatment. Abdominal fat weight and yield decreased ( $p<0.05$ ) in correspondence the level of inclusion of mulberry foliage meal in diets. The results suggest experiments with 10% lower levels of foliage mulberry meal in diets of hybrid chicken camperos for obtain a good growth performance and edible portions.

**Keywords:** Birds, camperos, *Morus alba*, production performance

### INTRODUCTION

The high costs of the conventional raw materials by the boom in the production of biofuels and the global economic crisis has an impact on animal production and especially in the poultry industry, where the feeds represent more than 65% of the total cost of production. The developing countries have had to seek alternative feeds for the birds feeding and promote quality products to market (Martínez *et al.*, 2011).

In the birds feeding have been investigated many alternatives, as tropical legumes, used for its availability and its high nutritious value. In this sense, mulberry (*Morus alba*), has been studied from the viewpoint agronomic, chemical and nutritional (Martín, 2004). This feed has a high production of green fodder and leaves from 15 to 28% Crude Protein (CP), amino acids and low fiber content compared with other tropical legumes, which due to its nutritive potential could be used as feedstock in diets for broiler chicken. Despite the beneficial characteristics of the mulberry, we found no literature sufficient of its use in high levels in the diets of broiler chickens and in special in hybrid camperos (Savón *et al.*, 2007).

The hybrid chicken camperos developed by the Institute of Poultry Science of Cuba is distributed in many countries of Latin American, comes from a different gene-based lines crossing several breeds, has good breast, assorted color plumage which distinguishes it from traditional broiler, has low mortality, accept fibrous feeds and consumers associate it with the chicken creole by its palatability and texture, therefore it is a suggestive research with this breed poultry (Villa *et al.*, 2001; Fumero *et al.*, 2009). The objective of the current study was to evaluate the effect of mulberry foliage (*Morus alba*) meal on growth performance and edible portions in hybrid chicken camperos.

### MATERIALS AND METHODS

**Sample:** Foliage of the mulberry tree (*Morus alba*) at 90 days were cut and packaged in nylon bags, then dried in the sun from 72 to 120 h on a cement floor, with layer thickness of 10 cm three times per day in order to increase the drying and uniformity were made, then leaves were separated from woody stems, finally, were ground in a hammer mill with a sieve

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Table 1: Dietary ingredients and nutrient levels in diets (fresh basis)

Ingredients, %	Starter				Grower				Finisher			
	0.00	10.00	20	30	0	10	20	30	0	10	20	30
Foliage mulberry meal	-	10.00	20.00	30.00	-	10.00	20.00	30.00	-	10.00	20.00	30.00
Corn	50.45	43.55	36.65	29.80	55.15	48.12	41.32	34.32	59.36	52.66	45.66	38.96
Soybean meal	41.8	38.70	35.60	32.45	36.17	33.20	30.00	27.00	31.00	27.70	24.70	21.40
Premix <sup>1</sup>	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Soybean oil	3.19	3.19	3.19	3.19	4.19	4.19	4.19	4.19	5.19	5.19	5.19	5.19
Choline	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
DL-Methionine	0.54	0.54	0.54	0.54	0.47	0.47	0.47	0.47	0.43	0.43	0.43	0.43
L-Lysine HCL	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Calcium carbonate	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
Dicalcium phosphate	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76
Calculated composition, %												
Dry matter	92.00	92.20	92.30	92.40	92.40	92.30	92.40	92.60	92.30	92.40	92.50	92.70
Crude protein	22.00	22.00	22.00	22.00	20.00	20.00	20.00	20.00	18.00	18.00	18.00	18.00
Crude Fiber	2.50	3.70	4.90	6.10	2.400	3.60	4.80	6.00	2.30	3.50	4.70	5.90
Ether extract	5.90	6.20	6.40	6.70	7.00	7.20	7.50	7.70	8.00	8.30	8.50	8.80
Metabolizable energy, MJ/kg	11.46	11.44	11.42	11.40	11.63	11.58	11.56	11.55	11.75	11.73	11.71	11.69
Lysine	1.38	1.36	1.34	1.33	1.20	1.18	1.16	1.14	1.00	0.98	0.96	0.94
Methionine + cystine	0.95	0.94	0.92	0.90	0.85	0.83	0.81	0.80	0.79	0.78	0.77	0.76
Available phosphorus	0.50	0.50	0.50	0.50	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45

<sup>1</sup>Each kg diet contains: 10×10<sup>6</sup> IU, vitamin A 1.5×10<sup>6</sup> IU, vitamin D 2100 mg, vitamin K 10000 mg, vitamin E 800 mg, vitamin B<sub>1</sub> 2500 mg, vitamin B<sub>2</sub> 10000 mg, pantothenic acid 2500 mg, vitamin B<sub>6</sub> 250 mg, folic acid 100 mg, biotin 15 mg, vitamin B<sub>12</sub> 60000 mg, Mn 8000 mg, Cu 60000 mg, Fe 50000 mg, Zn 200 mg, Se 800 mg, I 500 mg Co

of 1 mm and stored in warehouses of feed to their future employment (Yin *et al.*, 1993).

**Chemical composition:** The chemical analyses of the foliage mulberry meal were conducted by quintuplicate in the Analytical Chemistry Laboratory, Faculty of Agriculture and Horticulture, Humboldt University, Germany. It took 3 kg of foliage mulberry meal for the laboratory analyses. The samples were stored at room temperature in airtight glass jars.

The Dry Matter (DM), Ash Content (Cz), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) (AOAC, 2006), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were determined (Van Soest *et al.*, 1991). Calcium (Ca), total Phosphorus (P), Magnesium (Mg) sodium (Na) and Copper (Cu) were determined by atomic absorption spectrophotometry Perkin Elmer (USA).

For determination the amino acid profile, 0.5 g of samples were subjected to acid hydrolysis with 6 N hydrochloric acid for 24 h at 105°C. Then they were filtered with filter paper, transferred to a volume of 25 mL and made to volume with citrate buffer pH 2.2 (Davies and Thomas, 1973). An amino acid analyzer

Alpha Plus 4151 was used (England). The amino acids were expressed as percentage of the dry matter.

**Treatments and experimental conditions:** The research was conducted in June, July and August 2010 in the Experimental Poultry Unit of the University of Granma, located in the Granma province, Cuba. A total of 400 male hybrid chicken camperos of 1-day old were placed for 70 days according to a completely randomized design with four treatments, 10 replicates/treatment and 10 birds/replicate. Dietary treatments consisted in the inclusion of high levels of 0 (T0), 10 (T1), 20 (T2) and 30% (T3) of foliage mulberry meal. The diets were prepared in three stages: starter: 0-28 days, grower: 29-57 days and finisher: 58-70 days. Dietary ingredients and nutrient levels in diets are presented in the Table 1.

Each replicate consisted in one paddock with deep bed of rice husks and 10 birds/m<sup>2</sup>. The feed was adjusted twice weekly according the body weight and was offered in two portions (7:20 am to 2:20 pm) in linear feeders of 6 cm/bird. Water ad libitum in nipple drinkers was provided. Heating for 14-days-old in an illuminated 24 h light was used. This study was carried out according with Cuban guidelines for poultry

husbandry and experimental protocol (Fumero *et al.*, 2009).

**Growth performance:** All birds were weighed at 1, 42 and 70 days. Feed intake was measured daily during all experimental weeks, by the difference between the offer and rejection. Feed Conversion Ratio (FCR) was calculated as the amount of feed eaten for gain of kg of Body Weight (BW). Viability was determined as the difference between the initial number of birds and recorded mortality.

**Edible cuts weight and yield and sensory quality of breast and thigh meat:** Ten (10) birds/treatment were sacrificed by bleeding of the jugular vein after four hours of feed fasting (water was offered ad libitum). Carcass weight was determined by weighing the birds before slaughter, after the carcass, breast, thigh plus leg and abdominal fat were weighed. Thigh and breast samples were kept frozen at -20°C.

Thigh and breast sensory quality was determined by a panel of 10 tasters selected from Center of Study of Animal Production, University of Granma, Granma, Cuba. Meat samples were thawed and cooked in water without salt for 30 min at 80°C (Ruiz *et al.*, 2001). Panel members were selected according to the following criteria: healthy, non-smokers did not have the habit of consuming coffee and/or alcoholic beverages, men and women between 25 and 55 years.

The sensory quality parameters surveyed were: aroma (normal or abnormal), flavor (normal or abnormal), tenderness (normal, tough, very tough, very soft) and color (normal, pale or intense).

**Statistical analysis:** The data were analyzed through the descriptive statistics model. The mean and the standard deviation were determined and, when necessary, Duncan (1955) test was used. The statistical software SPSS, version 17.0 was used. The viability was analyzed comparing the proportions in the statistical software COMPARPRO 1.0 (Font *et al.*, 2007).

## RESULTS

**Growth performance:** The inclusion of up 30% of foliage mulberry meal in the diets of hybrid chicken camperos decreased the BW to 42 and 70 days compared to the control treatment with significant differences ( $p < 0.05$ ) between treatments (Table 2). Also, the feed intake and FCR decreased to higher inclusion and foliage mulberry meal intake; however, the viability showed no significant differences ( $p > 0.05$ ) between treatments.

**Edible portions and sensory quality:** The Table 3 shown the weight and yield of the edible portions of hybrid chicken camperos when is included foliage mulberry meal in the diets. Carcass, breast, thigh plus leg and abdominal fat decreased progressively with the T1, T2 and T3 with significant differences ( $p < 0.05$ )

Table 2: Growth performance of hybrid chicken camperos fed with foliage mulberry meal

Indicators	Foliage mulberry meal, %				SEM
	0.00	10.00	20.00	30.00	
Initial BW, g	32.58	33.26	32.47	32.28	0.51
BW at 42 days, g	828.6 <sup>a</sup>	763.9 <sup>b</sup>	743.3 <sup>b</sup>	659.8 <sup>c</sup>	4.50
BW at 70 days, g	2033 <sup>a</sup>	1680 <sup>b</sup>	1539 <sup>c</sup>	1374 <sup>d</sup>	5.21
Feed intake, g	4432.02 <sup>a</sup>	3981.50 <sup>b</sup>	4079.00 <sup>b</sup>	3806.00 <sup>c</sup>	11.25
FCR, kg/kg	2.18 <sup>c</sup>	2.37 <sup>b</sup>	2.65 <sup>a</sup>	2.77 <sup>a</sup>	0.09
Foliage mulberry meal intake, g	0.00	385.79 <sup>b</sup>	394.08 <sup>a</sup>	366.20 <sup>c</sup>	10.10
Viability, %	100.00	99.00	99.00	99.00	0.35

<sup>a, b, c, d</sup>: Means with different superscript within lines differ significantly ( $p < 0.05$ ) according to Duncan's multiple-range test

Table 3: Edible portions of hybrid chicken camperos fed with foliage mulberry meal

Indicators	Foliage mulberry meal, %				SEM
	0.00	10.00	20.00	30.00	
Carcass weight <sup>1</sup> , g	1545.2 <sup>a</sup>	1263.2 <sup>b</sup>	1128.9 <sup>bc</sup>	979.1 <sup>c</sup>	6.28
Carcass yields, %	75.95 <sup>a</sup>	75.25 <sup>a</sup>	73.25 <sup>b</sup>	71.18 <sup>c</sup>	2.31
Thigh+leg weight, g	394.5 <sup>a</sup>	286.6 <sup>b</sup>	241.3 <sup>c</sup>	208.9 <sup>c</sup>	7.13
Thigh+leg yield, %	25.54 <sup>a</sup>	22.68 <sup>b</sup>	21.36 <sup>b</sup>	21.25 <sup>b</sup>	1.73
Breast weight, g	241.6 <sup>a</sup>	201.5 <sup>b</sup>	166.3 <sup>c</sup>	137.8 <sup>c</sup>	4.21
Breast yield, %	15.63 <sup>a</sup>	15.92 <sup>a</sup>	14.71 <sup>b</sup>	14.06 <sup>b</sup>	1.05
Abdominal fat weight, g	29.78 <sup>a</sup>	19.07 <sup>b</sup>	16.14 <sup>c</sup>	11.65 <sup>d</sup>	1.80
Abdominal fat yield, %	1.93 <sup>a</sup>	1.51 <sup>b</sup>	1.43 <sup>c</sup>	1.19 <sup>d</sup>	0.06

<sup>a, b, c, d</sup>: Means with different superscript within lines differ significantly ( $p < 0.05$ ) according to Duncan's multiple-range test; <sup>1</sup>: Carcass is considered without viscera, head, or feet; Thigh plus leg, breast and abdominal fat yields are expressed as carcass percentage

Table 4: Sensorial quality of the breast and thigh of hybrid chicken camperos fed with foliage mulberry meal

Indicators	Foliage mulberry meal, %							
	0		10		20		30	
	B	T	B	T	B	T	B	T
<b>Aroma</b>								
Normal	10	10	10	10	10	10	10	10
Abnormal	0	0	0	0	0	0	0	0
<b>Flavor</b>								
Normal	10	10	10	10	10	10	10	10
Abnormal	0	0	0	0	0	0	0	0
<b>Tenderness</b>								
Normal	10	10	10	10	10	10	10	10
Tough	0	0	0	0	0	0	0	0
Very tough	0	0	0	0	0	0	0	0
Very soft	0	0	0	0	0	0	0	0
<b>Color</b>								
Normal	10	10	10	10	10	10	10	10
Pale	0	0	0	0	0	0	0	0
Intense	0	0	0	0	0	0	0	0

Values represent the views of different assessors (10) involved in the sensory evaluation; B: breast; T: thigh

between treatments. However, panel members did not detect any differences in the sensory quality of the breast and thighs, which was presented in the Table 4.

## DISCUSSION

**Growth performance:** The viability showed that the secondary metabolites in this plant used up to 30%, did not cause morbidity and mortality to the birds, taking into account that the tropical foliages and especially mulberry, have secondary metabolites such as saponins, tannins, flavonoids, coumarins and reducing sugars, which in excess are antinutritional factors (Savón *et al.*, 2007).

Also, this research confirmed that the hybrid chicken camperos have more resistance to the stressing agents that the conventional lineages that the mortality can be up to 5% as was reported by Fumero *et al.* (2010). However, the birds that consumed foliage mulberry meal decreased the productive indicators of form gradual for 70 days.

The secondary metabolites and the NDF (27.28%) in the foliage mulberry meal could have decreased the growth performance; an excess of antinutritional can loss cause of digestible energy and nutrients, especially amino acids, fatty acids and minerals (Ca, Mg and Fe), regulating the voluntary intake of the birds (Savón *et al.*, 2007; Martínez *et al.*, 2010).

In this sense, the birds in T1 and T2 showed no significant differences between they ( $p < 0.05$ ), could be by the voluntary intake of the birds that increased by the endogens loss of nutrients; however, the birds of the

T3 decreased the feed intake with relation to other treatments with foliage mulberry meal, maybe the gastric capacity by the BW, the inclusion level of mulberry, chemical compositions and the palatability influenced in these results (Fumero *et al.*, 2009).

Although the FCR decreased with the inclusion of the T1, T2 and T3, Valdivié *et al.* (1990) had informed results similar (2.51 a 2.74) with saccharin levels in diets for broiler chickens. Also, Casamachin *et al.* (2007) found that the inclusion of 10 and 15% of foliage mulberry meal in diets for broiler chickens decreased the productive indicators in comparison to 5%, justified by the secondary metabolites and crude fiber. This indicates that in both lineages of broiler decreases the growth performance when used high levels of meal of foliage mulberry.

**Edible portions and sensory quality:** The decrease of BW in the birds of the T1, T2 and T3 determined the weight and yield of the edible portions, however the results were better to the reported by Fumero *et al.* (2010) and Martínez *et al.* (2010), with 66.70% y 70.80%, respectively.

The decrease of the breast weight and yield in the birds that consumed foliage mulberry meal could be by the lower feed intake and in special of lysine. This amino acid in the diets increases the breast weight in comparison to other muscles (Tesseraud *et al.*, 1999; Lucas *et al.*, 2007; Berri *et al.*, 2008). These results confirm that the inclusion of higher levels of foliage mulberry meal determined the results in the weight and yield of the birds.

Table 5: Chemical composition of the foliage mulberry meal (dry basis)

Protein and amino acids, %		Fiber and minerals, %	
Crude protein	26.55±1.26	Crude fiber	14.29±1.27
Lysine	2.10±0.25	NDF	27.28±2.15
Methionine	1.30±0.15	ADF	18.10±1.89
Threonine	2.70±0.12	Ash	14.00±1.64
Fenilalanine	3.50±0.10	Ca	2.40±1.75
Histidine	1.20±0.17	P	0.35±0.89
Arginine	3.20±0.14	Mg	0.49±1.27
Valine	4.10±0.37	Cu	7.10±1.10
Isoleucine	1.04±0.10	Na (mg/kg)	5.75±0.89
Cistine	0.50±0.18		
Tirosine	1.23±0.45		
Leucine	2.60±0.19		
Glycine	1.20±0.31		

Means±Standard Deviation (SD) (Dry matter 89.87%; ether extract 2.79%); NDF: neutral detergent fiber; ADF: acid detergent fiber

Nevertheless, the inclusion of foliage mulberry meal decreased the abdominal fat weight and yield by its crude fiber content (14.29%) (Table 5). This carbohydrate decreases the abdominal fat by the reduction of the cholesterol and Very Low-Density Lipoprotein (VLDL) in the blood flow (Villa *et al.*, 2001; Ayerza *et al.*, 2002; Martínez *et al.*, 2011).

In the sensorial quality of the breast and thigh (Table 4), it should be noted that this birds contains less excessive amount of fat, compared to conventional broiler, defined by its palatability and texture (Fumero *et al.*, 2009). These results confirm that the change in the chemical composition of the diets and in the body weight of the birds did not cause significant alterations in the breast and thigh. Also significant, because the sensory quality determines the product marketing and future economic benefits (Martínez *et al.*, 2010).

In conclusion, the results suggest experiments with 10% lower levels of foliage mulberry meal in diets of hybrid chicken lineage camperos for obtain a good growth performance and edible portions.

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