



Biological evaluation of Cuban ensiled food (CEF) in broilers feeding

Evaluación biológica del alimento ensilado cubano (AEC) en la alimentación de pollos de ceba

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A total of 600 unsexed EB₃₄ hybrid broilers were used from 14 days of age to evaluate productive parameters, edible portion weight and abdominal fat, by replacing part of the diet with Cuban ensiled food (CEF). The birds were distributed according to a completely random design into three treatments, with eight repetitions each, in which the control diet was partially replaced by 10 and 20 % of CEF taking into account the dry matter of the diet and the silage. Live weight, food intake, weight gain, and feed conversion were analyzed. For the edible portions, the carcass was cleaned and the weight of carcass, breast, abdominal fat, drumsticks and thigh was recorded. The resulting data were analyzed using the InfoStat statistical package. Although a decrease in intake was shown as the percentage of substitution increased (3323.0, 3296.0 and 3087.5 g, respectively), the live weight of the birds was not affected, which favored the introduction of this food into the broilers feeding. However, the study of edible portions showed that a 10 % substitution favors breast weight. The results show that it is possible to replace up to 20 % of the diet with CEF in broilers, without affecting behavioral indicators or the weight of edible portions, demonstrating the potential of this product in broilers breeding.

Se utilizaron 600 pollos de ceba del híbrido EB₃₄, sin sexar, a partir de los 14 días de edad para evaluar parámetros productivos, peso de porciones comestibles y grasa abdominal, al sustituir parte de la dieta por alimento ensilado cubano (AEC). Las aves se distribuyeron según diseño completamente aleatorizado en tres tratamientos, con ocho repeticiones cada uno, en las que se sustituyó de forma parcial la dieta control por 10 y 20 % de AEC teniendo en cuenta la materia seca de la dieta y del ensilado. Se analizó el peso vivo, el consumo de alimento, la ganancia de peso y la conversión alimentaria. Para las porciones comestibles se trabajó con la canal limpia y se registró el peso de la canal, la pechuga, la grasa abdominal y los muslos más encuentro. Los datos resultantes se analizaron mediante el paquete estadístico InfoStat. Aunque se mostró una disminución del consumo a medida que aumentó el porcentaje de sustitución (3323.0, 3296.0 y 3087.5 g, respectivamente), no se afectó el peso vivo de las aves, lo que favoreció la introducción de este alimento en la alimentación de pollos de ceba. Sin embargo, el estudio de porciones comestibles mostró que 10 % de sustitución favorece el peso de la pechuga. Los resultados indican que es posible la sustitución hasta de 20 % de la dieta por AEC en pollos de ceba, sin afectar indicadores de comportamiento ni el peso de porciones comestibles, demostrando la potencialidad de este producto en la crianza de pollos de ceba.

Key words: broilers, edible portions, performance, silage, substitution

Palabras clave: comportamiento, ensilaje, pollos de ceba, porciones comestibles, sustitución

Introduction

Industrial poultry farming is an efficient chain for obtaining high-quality, low-cost animal protein. However, raw matters for preparing diets are not always available in the required quantities in the tropical region. These productions

are basically made from imported products that demand high costs (Gaviria *et al.* 2021). For this reason, different strategies are currently being developed in which local resources that can constitute important sources of nutrients for bird rations are evaluated and used (Quishpe *et al.* 2023).

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There are several results where alternative sources with different forms of presentation in birds feeding are studied (Brickett *et al.* 2007 and Fernández-García *et al.* 2025). In the case of ensiled products, Gómez *et al.* (2014) used fish by-product silage in broilers, in which they highlighted the similarity of the results between the treatments. However, Betancourt *et al.* (2017) evaluated the silages of *Tithonia diversifolia* leaves and cassava bran in the broilers diet, alone and combined. The results described for the inclusion of these silages showed a decrease of the productivity in each of the indicators measured with respect to the control. They suggested taking into account the fiber content in alternative products and their percentage in the diet, when it refers to poultry feeding.

Researchers in Cuba developed a food product known as Cuban Ensiled Food (CEF). This technology consisted of generating a product from alternative sources already used in animal production, such as cassava root (*Manihot esculenta* Crantz) or sweet potato tuber (*Ipomoea batatas*), molasses B, Saccharomyces cream and vinasse from alcohol distillery (Lezcano *et al.* 2017). When evaluating the performance of growing-fattening pigs, daily weight gains between 700 and 850 g/d were achieved, with a 66 % substitution of corn in the ration. García-López *et al.* (2021) conducted studies with this product in the feeding of dairy cows. They also observed an improvement in milk quality, and considered this product as a feed option for cattle production.

Despite obtaining encouraging results in both species, studies in broilers are not yet being carried out. For this reason, and given the growing interest in incorporating alternative products in rations for broilers, the objective was to evaluate the CEF as a partial substitute for the diet and its effect on the main zootechnical indicators in performance and in the weight of edible portions.

Materials and Methods

The study was conducted at the experimental poultry unit of the Instituto de Ciencia Animal (ICA), Mayabeque, Cuba. For this purpose, a total of 600 unsexed broilers of the EB₃₄ hybrid, with 14 days old, were used, distributed in three treatments, according to a completely random design, with 8 repetitions, of 25 chickens each. A three-phase feeding system was applied: starter (1 to 21 d), growing (22 to 35 d) and finishing (36 to 42 d), in which diets as meal were used and formulated according to Rostagno *et al.* (2017) recommendations (table 1).

In each feeding stage, 10 and 20 % of the dry matter of the control diet (corn-soybean) CEF was replaced. The CEF was produced at the production plant from Héctor Molina sugar mill (Mayabeque, Cuba), according to the procedure described in the patent “Procedure for obtaining an ensiled food for animal production” (application number 2013-0122 and Grant Resolution number 4155/2016).

Before its use, homogeneous sample analyses of the batch were carried out in triplicate, in the Central Laboratory Unit of Instituto de Ciencia Animal. The chemical and microbiological composition of this food is shown in table 2.

Table 1. Composition and contribution of the control diet at each stage of breeding

Raw matter, %	Starter (1-21 d)	Growing (22-35 d)	Finishing (36-42 d)
Corn meal	46.48	54.16	59.22
Soybean cake with 45 % CP	43.86	35.61	31.28
Sunflower oil	5.39	5.74	5.02
Monocalcium phosphate	1.54	1.89	1.89
Calcium carbonate	1.32	1.19	1.21
Common salt	0.25	0.25	0.25
Vitamins and minerals ¹ premixture	1.00	1.00	1.00
DL-Methionine	0.16	0.16	0.13
Calculated contribution, %			
Metabolizable energy, MJ/kg DM ¹	12.97	13.39	13.39
Crude protein	23	20	18.5
P available	0.40	0.45	0.45
Calcium	0.95	0.95	0.95
Methionine + Cystine	0.90	0.85	0.80
Lysine	1.34	1.13	1.01

(1) Vitamin supplement: vitamin A, 10000 UI; vitamin D3, 2000 UI; vitamin E, 10 mg; vitamin K3, 2 mg; thiamine, 1 mg; riboflavin, 5 mg; pyridoxine, 2 mg; vitamin B12, 15.4 µg; nicotinic acid, 125 mg; pantothenate de Ca, 10 mg; folic acid, 0.25 mg; biotin, 0.02 mg (2) Mineral supplement: selenium, 0.1 mg; iron, 40 mg; copper, 12 mg; zinc, 120 mg; magnesium, 100 mg; iodine, 2.5 mg; cobalt, 0.75 mg

Table 2. Physicochemical and microbiological characteristics of sweet potato silage used in the bird's diet

Indicator	Value
Dry matter, %	22.28
Organic matter, %	86.24
Ashes, %	13.76
Gross fiber, %	2.16
Specific weight, %	1.03
Calcium, %	1.30
Phosphorus, %	0.32
Magnesium, %	0.49
Potassium, %	4.10
°Brix	18.10
pH	3.74
Lactic acid bacteria, log CFU/mL	9.08
Yeasts, log CFU/mL	8.31

The performance indicators were measured in all broilers that completed each stage: weekly food intake, viability, and live weight. Subsequently, feed conversion ratio, weight gain, and mortality were calculated and monitored daily.

At 42 days, eight birds per treatment were slaughtered as representative samples, taking into account the average live weight of each one. For this purpose, the birds were slaughtered by the method of bleeding the jugular vein described by [Sánchez \(1990\)](#). Subsequently, the abdominal cavity was divided and the accessory organs (liver and pancreas) and the digestive tract were removed for working with the carcass, without neck and without legs. The carcass was weighed and cuts were made to obtain the edible portions and abdominal fat, which were weighed with a SARTORIUS technical scale, with an accuracy of ± 0.1 g, to determine the weight of the carcass, breast, drumsticks + legs and abdominal fat.

The statistical study of the behavioral data was carried out through analysis of variance, according to a one-way model and the [Di Rienzo et al. \(2012\)](#) program was used. For carcass yield, analysis of variance was performed according to a one way model with factorial arrangement, treatments (3) x sex (2). In both cases, [Duncan \(1955\)](#) test was applied where necessary. For none of the studied variables was the interaction significant; therefore, the main effects are shown.

Results and Discussion

[Table 3](#) summarizes the zootechnical performance indicators studied during the experiment. The results show that partially replacement of the control diet with silage in the broilers feeding does not alter productive efficiency. Only a decrease in food intake was recorded in the treatment where 20 % of the diet was replaced; however, there was not effect in the rest of the measured indicators.

This result can be related to what [Pérez et al. \(2020\)](#) stated, when mentioning that the additives present in food can stabilize the microbiological system in the digestive tract, improve the digestibility of nutrients and promote a higher absorption rate, which promotes body gain and reduces the amount of food/kg of weight gain.

The similarity in the productive response between treatments is evident in the indicators of live weight, gain and conversion, which are related to the adequate supply of nutrients from the silage used. These effects coincide with the studies reported by [Lezcano et al. \(2016\)](#), when it was partially and totally replaced cereals in the diet of growing pigs and obtained a similar performance.

The results were superior to those reported in other experimental studies with chickens and protein silages ([Sarmiento-Franco et al. 2021](#)). These authors mentioned that the indicators of productive performance constitute zootechnical indices, essential to know in a practical way the animal response to the supply of a certain food in the diet. They added that this food could be considered suitable for various species, given its chemical and microbiological composition. They also highlighted the product's stability, making it one of the best alternative options for the region.

Similarly, the efficiency of CFE use by birds could be related to the nutrient contribution of each of the products used for its preparation, according to [Lezcano et al. \(2017\)](#). These authors linked some of the benefits of this new food to the presence of *Saccharomyces cerevisiae* yeasts, acidic pH and oligosaccharides present in vinasse according to [Hidalgo et al. \(2017\)](#), which are able to selectively activate the growth of microorganisms in the GIT and therefore improve animal physiology. Similar results were obtained by [Gaviria et al. \(2021\)](#) when they replaced 25 % of the protein in the diet with fish silage. As a result, they obtained equivalences between

Table 3. Evaluation of productive indicators in broilers at 42 days of age when replacing the diet with CEF

Indicators	Treatments				
	Control	10 % silage	20 % silage	SE $\pm$ Sign	Power of the test
Food intake (g), 14-42 d	3323.0 ^b	3296.0 ^b	3087.50 ^a	65.36 P=0.0368	0.5476
Live weight at 14 d, g	430.88	435.00	429.63	8.75 P=0.9024	0.0624
Live weight at 35 d, g	1340.25	1371.38	1295.88	28.58 P=0.1962	0.3140
Live weight at 42 d, g	1932.00	1934.63	1908.00	24.47 P=0.7023	0.08796
Conversion of 14-42 d	2.21	2.20	2.09	0.04 P=0.0804	0.3959
Weight gain of 14-42 d, g	1501.13	1499.63	1478.38	22.22 P=0.7240	0.0852

^{a,b} Different letters in the same row significantly differ (P<0.05), according to [Duncan \(1955\)](#), SE: Standard error

the productive, health and hematological parameters between the different treatments. [Martínez et al. \(2017\)](#) suggested that as products from the region are used, correctly processed and offered at adequate levels, they are able of producing excellent results both in the performance and in the edible portions of broilers.

According to [Rodríguez Galvis \(2012\)](#), rapid weight gain in birds is directly influenced by the morphofunctional integrity of the digestive system. Hence the importance of evaluating the indicators that measure the effect of food intake and its relation with live weight gain ([table 4](#)). Weight records for abdominal fat showed that they were inversely proportional to the increase in the inclusion level. These showed values of 29.75, 23.56 and 22.69 g for the control, 10 % and 20 % of inclusion, respectively. In addition, values of $P=0.4202$, standard error of 15.79 and power of the test of 0.3872 were reported. It is important to highlight that with respect to the breast weight, values favored by the substitution of the diet were observed when 10 % of the CEF was included.

The decrease in abdominal fat and the higher weight of the breast could be related to the substances present in the distillery vinasse contained in the silage, as proposed by [Hidalgo et al. \(2017\)](#). The mentioned authors used distillery vinasse as an additive in the broilers feeding and reported improvements in the studied indicators of meat yield. In this regard, [Al-abdullatif et al. \(2024\)](#) mentioned that the nutrients in distillery wastes are highly digestible and assimilable by birds, highlighting, in addition, that they act directly on the composition of the muscles and, therefore, on the breast, as was found when using 10 % CEF.

Conclusions

The obtained results suggest the possibility of replacing up to 20% of CEF in the rations of broilers, without affecting the viability of the animals, behavior and meat production. The use of agro-industrial products and by-products as silage in birds feeding is a relatively new field, so further researchers are recommended to complement the obtained information.

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Table 4. Effect of CEF as a partial replacement for the diet on the weight of edible portions of broilers at 42 days of age

Indicator, g	Effects	Means				
		Control	10 % silage	20 % silage	SE± and Sign	Power of the test
Live weight	Treatments	1910.81	1909.44	1890.81	19.34 $P=0.0903$	0.2214
Carcass	Treatments	1201.63	1213.00	1167.81	14.72 $P=0.0901$	0.2226
	Sex	Females 1115.42	Males 1272.88		12.02 $P=0.4202$	
D+T	Treatments	397.13	402.88	388.56	7.74 $P=0.4280$	0.1085
	Sex	Females 368.54	Males 423.83		12.02 $P<0.0001$	
Breast	Treatments	328.56 ^a	358.19 ^b	326.50 ^a	6.27 $P=0.0012$	0.5394
	Sex	Females 319.21	Males 356.29		5.12 $P<0.0001$	

D + T (drumsticks + thigh)

^{a,b} Different letters within the same row significantly differ ($P<0.05$) according to [Duncan \(1955\)](#), SE: Standard error

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