FOLIA
Amazónica
Revista del Instituto de Investigaciones
de la Amazonía Peruana

EFFECT OF THE *Uncaria tomentosa* LEAVES HYDROALCOHOLIC EXTRACT ON PHYSIOLOGICAL PARAMETERS AND PERFORMANCE INDICES OF BROILER CHICKENS

Jairo LOAYZA-BESARES[1], José Eduard HERNÁNDEZ-GUEVARA[2], Flor de María GUTIERREZ-RENGIFO[1], Daniel Marco PAREDES-LÓPEZ[2*]

[1] Escuela Profesional de Zootecnia, Universidad Nacional Agraria de la Selva, Carretera Central Km 1.21, Tingo María,Huánuco, Perú.

[2] Departamento de Ciencia Animal, Universidad Nacional Agraria de la Selva. Carretera Central Km 1.21, Tingo María, Huanuco, Perú.

*Corresponding author: daniel.paredes@unas.edu.pe

ABSTRACT

The continuous use of antibiotics as growth promoters in poultry has caused bacterial resistance and public health risk. The aim of this study was to determine the effect of hydroalcoholic extract from *Uncaria tomentosa* (HAEUt) leaves on physiological parameters and performance indices of broiler chickens. One hundred COBB 500 chickens of 1 day old and 42.22 g weight were used. The HAEUt was supplemented in drinking water at 0, 1.34, 2.68 and 4.03 mg/mL and from 1 to 42 days. The hematocrit, hemoglobin, total protein, albumin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), daily feed intake (DFI), daily weight gain (DWG), and the feed conversion rate (FCR), at 42 days old was determined. A complete randomized design (CRD) with a factorial arrangement was used. Hematocrit, hemoglobin and albumin increased as the HAEUt increased ($p<0.05$); at the same time, DFI decreased with the increase in the HAEUt ($p<0.05$), while the DWG and the FCR did not vary ($p>0.05$). Conclusively, the HAEUt improved the performance of the broiler chickens, because the HAEUt would modulate anorexigenic hypothalamic neuropeptides which might be responsible for DFI reduction and maintaining DWG and FCR of chickens and it would improve farmers' incomes.

KEYWORDS: Feed intake, growth promoter, hemoglobin, weight gain

EFECTO DEL EXTRACTO HIDROALCOHÓLICO DE HOJAS DE UÑA DE GATO *Uncaria tomentosa* SOBRE PARÁMETROS FISIOLÓGICOS Y RENDIMIENTO PRODUCTIVO DE POLLOS DE CARNE

RESUMEN

El uso de antibióticos como promotores de crecimiento en la producción avícola ha puesto en riesgo la salud pública. El objetivo de este estudio fue determinar el efecto del extracto hidroalcohólico de la hoja de *Uncaria tomentosa* (EHAUt) sobre los índices de performance de pollos broilers. Se utilizaron 100 pollos COBB 500 con peso promedio inicial de 42.22 g. El EHAUt se suplementó en agua de bebida a 0, 1.34, 2.68 y 4.02 mg/ml, de 1-42 días de edad. Se determinaron perfiles de hematocrito, hemoglobina, proteína total, albumina, alanina aminotransferasa (ALT) y aspartato aminotransferasa (AST), consumo diario de alimento (CDA), ganancia de peso (GP) y conversión alimenticia (CA) a los 42 días de edad. Para el análisis estadístico se utilizó el DCA con arreglo factorial. El hematocrito, la hemoglobina y la albumina incrementaron con el incremento del EHAUt ($p<0.05$); así mismo el CDA disminuyó con el incremento de EHAUt ($p<0.05$), sin embargo, la GP y CA no variaron ($p>0,05$). En conclusión, el EHAUt mejoro el performance de los pollos debido a que los fitocompuestos de EHAUt modularían los neuropéptidos anorexigénicos hipotalámicos los que reducirían el CDA y mantendrían la GP y la CA.

PALABRAS CLAVE: Consumo de alimento, ganancia de peso, hemoglobina, promotor de crecimiento

INTRODUCTION

The continuous use of antimicrobials to promote the well-being, health, and production of different animal species for food consumption, creates the growth of microorganisms that are resistant to them; at the same time, these antibiotics are accumulated in the tissue of the animal organism, which causes collateral effects on public health (Zalewska *et al.*, 2021; Tiseo *et al.*, 2020; Muloi *et al.*, 2018; Sakai *et al.*, 2016; Jechalke *et al.*, 2014; Soni *et al.* 2022; Hou *et al.*, 2023; Abadi *et al.*, 2019; Kimera *et al*., 2020; Ayukekbong *et al.*, 2017; Oloso *et al.*, 2018). Besides this problem, the antibiotic residuals from animals' use accumulate in the environment like soil, water bodies, and wildlife, causing antibiotic resistance of pathogens at this level (Bilandžić *et al.*, 2015). Thus, the incorporation of natural products with nutraceutical, antioxidant, immune-stimulating, anti-inflammatory, and antiviral properties for the well-being, health, and production of animals for food consumption is a current tendency, in order to obtain products of animal origin that are innocuous for public health (Paredes-López *et al.*, 2019; Sugiharto, 2016; Jahanian & Mirfendereski, 2015; Boostani *et al.*, 2015; Gerasopoulos *et al.*, 2015; Soltani *et al.*, 2016).

This scenario brings us to research new forms of controlling these pathogens through the use of plant extracts or essential oils containing active antimicrobial, antioxidant, and immunomodulation compounds; which, integrally, can act by moderating the microbiota, the structure, and the gastrointestinal health, as well as the performance indices in livestock and poultry (Murugesan *et al.*, 2015; Skoufos *et al.*, 2020; Sugiharto, 2016; Paredes-López *et al.*, 2023; Paredes-López *et al.*, 2024; Vargas-Arana *et al.*, 2022)

Uncaria tomentosa, commonly known as cat's claw, originally from the southeast Americas, is a plant containing antioxidants, immunomodulators, antivirals, and anti-inflammatory components (El-Saber *et al.*, 2020; Jia-Hao *et al.*, 2020; Navarro *et al.*, 2019; Azevedo *et al.*, 2019; Tomazelli *et al.*, 2018; Navarro-Hoyos *et al.*, 2017; Navarro *et al.*, 2015; Zhang *et al.*, 2015). It is used among most of the rural population in the Amazon region of Peru, in their folk medicine (Valdiviezo-Campos *et al.*, 2020; Obregón, 1997). However, due to the bioactive compounds *U. tomentosa* can also be used by farmers to improve animal well-being, health, and production. A few numbers of studies regarding the effect of *Uncaria tomentosa* bark extracts on hematological and biochemical profiles and performance indices in animal species, including rats, mice, chickens, and fish, such as *Oreochromis niloticus* and *Pterophyllum scalare*, have shown similar results (Paredes- López *et al.*, 2018; Méndez *et al*., 2014; Cala & Kochenborger, 2015; Yunis-Aguinaga *et al.*, 2015; Ibrahim *et al*., 2009). Therefore, it was hypothesized that *U. tomentosa* leaf extracts may produce important effects on the well-being and production of broiler chickens, which remains to be explored.

The goal of this study was to determine the effect of different levels of a hydroalcoholic extract from *Uncaria tomentosa* leaves, on the well-being and production of broiler chickens.

MATERIAL AND METHODS

HYDROALCOHOLIC EXTRACT OF *U. tomentosa*

Cat's claw leaves from mature plants, more than eight years old, were used; they were harvested in the Rupa Rupa district of the Leoncio Prado province in the Huánuco region of Peru, settled at 09°17'58" S 76°01'07" W, 660 m a.s.l. and dried for forty-eight hours in the shade, and later in an oven at 65°C for two hours, to then be ground in a hammer mill to obtain a homogenous sample. The HAEUt was obtained by placing 200 g of flour from the leaves in a jar, adding 70% ethanol, (1/4, W/V) and letting it sit for forty-eight hours so that the extract could develop. The filtered extract was submitted to an evaporation of the ethanol procedure, using a BUCHI R-200 rotary evaporator, and later the sample was dried in an oven at 65°C (Miranda, 2002).

TOTAL POLYPHENOL CONTENT AND INHIBITION COEFFICIENT (IC_{50}) OF THE HAEUt

The total polyphenol content of the *Uncaria tomentosa* leaves was determined using the Folin-Ciocalteu colorimetric method. In a test tube, 50 µL of the extract, 800 µL of water and 100 µL of the Folin-Ciocalteu reactor were added. It was stirred and later left to rest for eight minutes. Then 50 µL of Na_2CO_3 at 20% was added and after an hour in the darkness the absorbency at 760 nm was read. Gallic acid solutions from 50 to 500 µg/mL were used to construct the calibration curve. The results were expressed in mg equivalent to gallic acid (GAE)/g of the extract (Abeysinghe *et al.*, 2021).

The antioxidant capacity of the hydroalcoholic extract from *U. tomentosa*, was evaluated using the 50% inhibition coefficient (IC_{50}), by means the method of isolating the 1,1diphenil-2-picrylhidrazyl (DPPH) free radical (Sandoval *et al.*, 2000; Halliwel, 1994). To do this, 975 µL of a 100 uM solution of DPPH was made to react with 25µL of five different solutions, at concentrations of 130, 325, 650, 825.5 and 1083.33 ug/mL of HAEUt in each one. The readings were taken with an Electron Corporation Genesys 6 UV and visible light spectrophotometer model at 515 nm every thirty seconds during ten-minute period.

EXPERIMENTAL CHICKENS AND SUPPLEMENTATION

The chickens were raised at 09°17’58” S 76°01’07” W, and an altitude of 660 m a.s.l. with an annual pluvial precipitation of 3293 mm, an average annual temperature of 24.8°C, and a relative humidity of 80% (SENAMHI, 2021). One hundred male chickens COBB 500 line of one day old with an average weight of 42.22± 3.02 g distributed into four supplementations with five replicates and five birds per each were used. Each supplementation consisted of adding 0, 1.34 (80 IC_{50}), 2.70 (160 IC_{50}) and 4.03 (240 IC_{50}) mg/ml of HAEUt to the drinking water, which was given ad lib from one to 42 days old. The birds were kept in twenty experimental cages that were 1 m^2 in area and 0.6 m high, with a density of five birds m^{-2}. The birds from each of the supplementations received the same diet, which was formulated according to the cobb 500 requirements (Rostagno, *et al.*, 2017) (Table 1) and the nutritional composition of this formulated diet was determined (Table 2).

HEMATOLOGICAL AND METABOLIC BLOOD PROFILES

Two whole blood with heparin and two serum samples per replicate were taken from chickens at forty-two days old, being a total of forty blood and serum samples and the extraction was from the wing vein with a 21 gauge and 1.5 inch long needle. The whole blood was used to examine the hematocrit and hemoglobin, while the transaminase, albumin and serum protein profiles were determined from the blood serum. The serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), total protein (TP), albumin (Alb) and hemoglobin were determined according to the methods described by Evans & Duncan (2005) using an Auto Chemistry Analyzer-AS 830 spectrophotometers at 515 and 530 nm, using specific kits (QAC-España). The hematocrit was determined using the microhematocrit technique at 11,000 rpm (Samour *et al.*, 2016) in a Kert Lab Tom’s (USA Science Tech Group) centrifuge.

INDICES OF PRODUCTIVE PERFORMANCE

To determine the effect of the HAEUt on the productive performance of the broiler chickens, the indices for daily feed intake (DF), the daily weight gain (DWG), and the feed conversion rate (FCR) during a forty-two-day period as main indices for evaluating the performance of the animal production (Ogbuewu *et al.*, 2022) were evaluated.

STATISTICAL ANALYSIS

The IC_{50} and the polyphenol content were determined using a linear regression, Y = a ± bx. The blood profile and the productive indices were analyzed using a completely randomized design (CRD), with four supplementations and five replicates each. The data was analyzed using a variance analysis and the 5% Tukey test. The variance analyses were done with Infostat statistical software (Infostat Software, 2017).

Table 1. Diets for male broilers chicken in initial (1-7), growth (8-21) and fattening (22-33 days) stage (% per 100 mg)

Feed ingredient	Rearing stage		
	Initial	Growth	Fattening
Corn	52.30	51.20	53.96
Palm oil	2.12	4.46	5.50
Soybean cacke, 46%	35.42	39.88	36.37
Extrused soybean	5.00	-	-
Calcium carbonate	0.89	0.79	0.75
Fosfato bicálcico	0.21	1.80	1.58
Salt	0.23	0.22	0.20
Premezcla vit + min.	0.15	0.15	0.10
Aflaban	0.05	0.05	0.05
Coccidiostat	0.05	0.05	0.05
Butil hidroxi toluene	0.05	0.05	0.05
Coline chloride	0.25	0.20	0.20
Sodium butirate	0.10	0.10	0.10
Sodium bicarbonate	0.46	0.45	0.44
Lisine, 78.4%	0.31	0.22	0.24
Metionine, 99%	0.25	0.23	0.22
Treonine, 98%	0.11	0.09	0.09
Valine, 99%	0.09	0.06	0.06
BMD (10%)	0.00	0.00	0.00
Oxitetraciclin, 99%	0.00	0.00	0.00
Total	100.00	100.00	100.00

Table 2. Nutritional composition of the diets for male broiler chickens supplemented with HAEUt in the initial, growth, and fattening stages (1-33 d old).

Diet	Dry Matter (DM) (%)	Ash (% of DM)	Crude protein (% of DM)	Ethereal extract (% of DM)	Total fiber (% of DM)	Nitrogen free extract (% of DM)
Initial stage	90.10	7.12	23.5	5.23	2.43	52. 27
Growth stage	91.24	6.81	22.13	7.02	2.32	52.96
Fattening stage	88.72	6.12	20.34	7.92	2.40	51.91

RESULTS

POLYPHENOL CONTENT AND 50% INHIBITION COEFFICIENT OF THE HAEUt

The polyphenol content was 5.48 ± 0.31 mg/ of AGE/ g of dried extract and the inhibition coefficient of the hydro alcoholic extract from the cat's claw leaves or the 50% isolation of the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical; was 16.78 ± 1.47 μgmL^{-1} of HAEUt.

EFFECT OF THE HAEUt ON THE HEMATOLOGICAL AND BLOOD METABOLITES PROFILES

The results of the total serum protein (TP), albumin (Alb), hemoglobin (Hgb;), hematocrit (HCT), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) profiles are shown in Table 3. The hematocrit, hemoglobin and albumin profiles increased, in relation to the control, when the level of HAEUt was increased in the drinking water ($p<0.05$) (Table 3); In addition, hematocrit profile was higher in the chickens supplemented 4.03 mg mL^{-1} than the supplemented 1.34 mg mL^{-1} of HAEUT ($p<0.05$).

EFFECT OF HAEUt ON THE PERFORMANCE INDICES OF BROILER CHICKENS

The effect of the hydroalcoholic extract from cat's claw leaves on daily feed intake (DFI), weight gain (WG) and feed conversion rate (FCR) in broiler chickens at 42 days of age is shown in Table 4. As the level of the cat's claw leaf hydroalcoholic extract increased in the drinking water, the daily feed intake was reduced ($p<0.05$). Nonetheless, the daily weight gain, as well as the feed conversion rate, did not vary ($p>0.05$) as the level of HAEUt increased (Table 4). These results show that the HAEUt promotes better efficiency in the use of nutrients from the diet.

DISCUSSION

The high extraction levels of Hydroalcoholic extract of *Uncaria tomentosa* (HAEUt) in the leaves of cat's claw in the present study are possibly due to the high solubility of its phytochemical compounds in alcohol, its affinity and chemical structure, and other factors such as physicochemical properties, solvent polarity, and the extraction time (Romero, 2012). The HAEUt, in the present study, contains similar concentrations of polyphenols than 5.54 mg of AGE/g of bark extract obtained by Tomazelli *et al.* (2018) and more polyphenols than those reported in another previous study where was obtained 3.43 and 3.64 mg of AGE/g of *U. tomentosa* leaf and bark extract, respectively (Navarro *et al.*, 2015). This level of polyphenol in the leaves,

Table 3. Hematological and blood metabolites profiles of chickens at 42 days old supplemented with HAEUt.

Blood profiles	p-value	HAEUt Level			
		0.00 mg mL^{-1}	1.34 mg mL^{-1}	2.70 mg mL^{-1}	4.03 mg mL^{-1}
HCT (%)	p<0.05	30.70 ± 2.45^{c}	32.40 ± 1.71^{b}	33.70 ± 2.50^{ab}	34.10 ± 2.96^{a}
Hgb (g/dL)	p<0.05	9.64 ± 1.15^{b}	10.71 ± 1.10^{a}	10.76 ± 1.40^{a}	11.15 ± 1.91^{a}
TP (g/dL)	p>0.05	2.84 ± 0.34	2.71 ± 0.37	2.71 ± 0.23	2.81 ± 0.21
Alb (g/dL)	p<0.05	1.19 ± 0.15^{b}	1.33 ± 0.31^{a}	1.35 ± 0.13^{a}	1.41 ± 0.40^{a}
AST (UI/L)	p>0.05	159.51±14.69	159.35±13.91	156.66± 18.75	154.49± 18.59
ALT (UI/L)	p>0.05	12.24 ± 7.42	13.71 ± 9.5	14.58 ± 9.91	15.41±9.42

abc: different letters within the same line indicate statistical differences (p<0.05). HAEUt: hydroalcoholic extract of U. tomentosa leaf, IC50: 50% inhibition coefficient, HCT: hematocrit, Hgb: hemoglobin, TP: total protein, Alb: albumin, AST: aspartate aminotransferase, ALT: alanine aminotransferase.

Table 4. Performance indices of broiler chickens at 42 days of age supplemented with HAEUt.

Productive indices	p-value	C.V. (%)	HAEUt Level			
			0.00 mg mL^{-1}	1.34 mg mL^{-1}	2.70 mg mL^{-1}	4.03 mg mL^{-1}
DFI (g)	p<0.05	1.61	112.20±1.30^{a}	111.60±1.14^{a}	110.40±2.07^{a}	107.80±2.17^{b}
WG (g)	p>0.05	3.75	57.40±1.76	59.20±3.53	59.53±0.82	59.72±1.83
FCR	p>0.05	4.5	1.96±0.07	1.89±0.13	1.86±0.02	1.81±0.07

abc: Different letters within the same line indicate a statistical difference (p<0.05). DFI: daily feed intake, WG: weight gain, FCR: feed conversion rate.

which are main components of the *Uncaria tomentosa* bark extracts (Dreyfus *et al.*, 2010), is one of the principal chemical groups with antioxidant activity (Dreosti, 2000). The extract from the bark of this plant contains around one thousand times the total antioxidants phytocompounds compared to various plants used in diets around the world (Martínez *et al.*, 2000), and these antioxidants phytocompounds act by directly isolating the peroxyl radical and DPPH, which are potent oxidant of cells (Pilarski, *et al.*, 2006; Sandoval *et al.*, 2000; Haliwell, 1994).

The IC_{50} of the HAEUt obtained in the present study (16.78 ± 1.47 μgmL-1) shows a potent antioxidant activity. This IC_{50} is lower than that reported in a study of *U. tomentosa* leaves, which was 10.68 ± 0.64 μgmL-1 (Azevedo *et al.*, 2019) and greater than the IC_{50} reported in another previous study using an atomized aqueous extract from *U. tomentosa* bark, which was 105.03 ug/mL (Sandoval, 2012). In the same manner, greater than the obtained in other previous study, where using extract from the bark of cat's claw in a lyophilized and micro pulverized form, an IC_{50} of 18.0 and 150.0 μg/mL were reported (Sandoval *et al.*, 2000). Nonetheless, the IC_{50} of the HAEUt in the present study was found to be within the IC_{50} intervals (22.26 - 2.13 μgmL^{-1}) reported for fifteen components with antioxidant activity for *Uncaria rhynchophylla* (Li *et al.*, 2017).

EFFECT OF THE HAEUt ON THE HEMATOLOGICAL AND BLOOD METABOLITES PROFILES

The hematological and blood metabolites profiles in the present study are within the normal profiles for chickens (Reece, 2015). The increase of hematocrit and hemoglobin by the supplementation of HAEUt in the present study could be associated to the level of bioactive, antioxidant, and immunostimulant phytocompounds that the extract from the cat's claw leaves contains, such as the polyphenols reported in this study and others (El-Saber *et al.*, 2020; Jia-Hao *et al.*, 2020; Azevedo, *et al.*, 2019; Navarro *et al.*, 2015). These results are similar to previous studies in broiler chickens for which an atomized aqueous extract from the bark of cat's claw was supplemented (Paredes-López *et al.*, 2018; Saavedra, 2008).

The main polyphenol compounds from the *Uncaria tomentosa* extracts act as isolators of free radicals and as inhibitors of the peroxidation of lipids, and they also have the capacity to interact directly with biological membranes, causing them to be more resistant to oxidative alteration (Dreifus, *et al.*, 2010; Sandoval *et al.*, 1998), thus diminishing the lysis of circulatory cells such as erythrocytes. Nonetheless, in other similar previous studies were not found an effect from the HAEUt on the erythrocyte and hemoglobin profiles at 1-14 d old and 15-27 d old broiler chickens (Quijano-Rojas, 2016; Alejo-Cervantes, 2016), nor from the extract of the *U. tomentosa* bark for the same profiles in rats, mice and fish (Méndez, *et al.*, 2014; Ibrahim, *et al.*, 2009; Cala & Kochenborger *et al.*, 2015; Yunis-Aguinaga, *et al.*, 2015).

The albumin profiles obtained from the chickens which received the supplementation of HAEUt in their drinking water in the present study, increased ($p<0.05$) in relation to the control, however, the profile for this metabolite was similar among the chickens which received the HAEUt at different levels. These results could be associated with the *U. tomentosa* extract anti-inflammatory effect in birds (Yunis-Aguinaga *et al.*, 2015; Dominguez *et al.*, 2011; Bendich, 1993). This result is similar to that obtained in a study of broiler chickens where different levels of atomized cat's claw bark extract were used and the albumin increased due to the interaction of the level of the bark extract and the age of the chickens (Paredes-López *et al.*, 2018); Notwithstanding, these results contrast with others previous results that have been obtained in rats and fish, where there was no variation in the albumin levels with the increase of the levels of extract from cat's claw bark in the diets (Méndez *et al.*, 2014; Cala & Kochenborger, 2015), it may be explained because of different response by each animal species to the *U. tomentosa* phytocompounds.

No changes were reported for the total protein profile in relation to the supplementation of the HAEUt in the drinking water; this might be associated with the results that *U. tomentosa* extract did not improve weight gain as a performance indice obtained in the present study. Nonetheless, different results were obtained with Nile tilapia and angelfish (*Pterophyllum scalare*), for which the total protein increased proportionately with *U. tomentosa* bark extract in the diets (Cala & Kochenborger 2015), and from the interaction between the levels of *U. tomentosa* bark extract and the ages of broiler chickens (Paredes-López *et al.*, 2018).

The no variation of the AST profiles in chickens in the present study are associated with the anti-inflammatory effect of the HAUt which is also associated with the increase in albumins in the present study. Similar to those AST profiles were obtained in a previous study carried out with broiler chickens where an atomized cat's claw bark extract was supplemented in the drinking water; however, the ALT in the same study increased due to the interaction between the level of extract and the age of the chickens (Paredes-López *et al.*, 2018)

Conversely, in other studies in rats, mice and fish, a considerable increase in one or both enzymes have been reported with increasing doses of *U. tomentosa* extract and it has been associated with a response to toxic effects from the bark extracts of this plant (Méndez *et al.*, 2014; Ibrahim, *et al.*, 2015; Cala & Kochenborger, 2015). These results probably are due to a lower concentration of toxic bioactive compounds in the *U. tomentosa* leaves than in the bark, or a greater tolerance to the toxic effect of *U. tomentosa* bark in birds, when compared with rats, mice, and fish.

EFFECT OF HAEUt ON THE PERFORMANCE INDICES OF BROILER CHICKENS

The reduction of feed intake in the chickens supplemented with 4.03 mg mL^{-1} in the present study could be related to the fact that the HAEUt at these level contains the amount of phytochemical compounds which causes similar effects to those containing some phytogenic additives used in chicken diets which causes a modulation of anorexigenic hypothalamic neuropeptides responsible for higher feed efficiency by feed intake reduction and maintaining body weight (Flees *et al.*, 2020).

The HAEUt might also have similar effects to other phytochemical additives for diets, which modulate the intestinal microbiota, increasing the digestibility of the dry matter and the height of the intestinal villi, thus increasing nutrient absorption (Murugesan, *et al.*, 2015; Yunis-Aguinaga, *et al.*, 2015). At the same time, improvement in the feed efficiency in broilers chicken obtained in the present study might be related to the anti-inflammatory effect of *U. tomentosa* (Rojas-Duran *et al.*, 2012) in broilers at the hepatic tissue level, improving the hepatic metabolism interfered with the accumulation of lipids which are produced from high calorie diets during the fattening phase (Araujo *et al.*, 2018)

The no variation in weight gain might be associated with the no change in the blood total protein obtained in the broiler chickens in this study; it means that the HAEUt does not enhance protein synthesis in broilers chicken. These findings are supported by other previous studies reported in COBB chickens supplemented atomized extract from the bark of cat's claw at levels of 0.53, 1.05 and 2.1 mg mL^{-1} (Paredes *et al.*, 2018), and others with a hydro alcoholic extract from the leaves of this plant during the phases of 1-14 days and 15-27 days old chickens (Quijano-Rojas, 2016; Alejo-Cervantes, 2016); as well as those obtained in *Oreochromis niloticus* and *Pterophyllum scalare* (Cala & Kochenborger, 2015), where no effect from the *U. tomentosa* bark extract on weight gain was observed at 60 days of feeding with levels of 150, 300 and 450 mg per Kg of bark extract diet from this plant. Also, similar results have been shown in other previous studies in rats, where the levels of 75 and 150 mg of extract from *U. tomentosa* bark per Kg of feed administered for ninety days had no effect on the weight gain (Méndez *et al.*, 2014).

Nonetheless, these results contrasts with those from studies in *Oreochromis niloticus* (Yunis-Aguinaga *et al.*, 2015) where levels of 75, 150, 300 and 450 mg of *U. tomentosa* per Kg of feed recorded during 28 days, revealed an increase in the weight gain as the level of bark extract from this plant increased; and in another study in rats, where 10 mg of *U. tomentosa* extract administered in an oral form for ninety days, rats increased the weight gain (Ibrahim *et al.*, 2009). This is the first study showing that the effect of *U. tomentosa* reduces the daily feed intake without changing the feed conversion rate and the weight gain in broilers chickens.

CONCLUSIONS

The hydroalcoholic extract from cat's claw leaves improved the well-being and the production of the broiler chickens by increasing hematocrit, hemoglobin, albumin profiles, reducing the daily feed intake and maintaining the daily weight gain and feed conversion rate. It might be because, HAEUt phytocompounds would modulate anorexigenic hypothalamic neuropeptides which reduce chicken feed intake, maintaining weight gain and feed conversion rate by using the nutrients from the diet more efficiently. Nonetheless, more studies should be carried out to determine the potential use of HAEUt as a phytochemical additive in the diets of chickens to promote growth.

REFERENCES

Abadi, A.T.V.; Rizvanov, A.A.; Haertlé, T.; Blatt, N.L. 2019. World Health Organization report: current crisis of antibiotic resistance. *Bio Nano Science*, 9:778–788. DOI: http://dx.doi.org/ 10.1007/s12668-019-00658-4

Abeysinghe, D.T.; Kumara, K.A.H.; Kaushalya, K.A.D.; Chandrika, U.G.; Alwis, D.D.D.H. 2021. Phytochemical screening, total polyphenol, flavonoid content, in vitro antioxidant, and antibacterial activities of Sri Lankan varieties of *Murraya koenigii* and *Micromelum minutum* leaves. *Heliyon*, 7 (7). DOI: http://dx.doi.org/10.1016/j.heliyon. 2021.e07449

Alejo-Cervantes, L. 2016. *Extracto de la hoja de uña de gato (Uncaria tomentosa) en la etapa de crecimiento, sobre los perfiles bioquímicos sanguíneos y parámetros productivos en pollos de carne.* Tesis de pregrado, Universidad Nacional Agraria de la Selva, Tingo María, Perú. 58pp.

Araujo, L.C.C.; Karla, B.; Feitosa, B.; Murata, G.M.; Furigo, I.C.; Teixeira, S.A.; Lucena, C.F.; Ribeiro, L.M.; Muscará, M.N.; Costa, S.K.P.; Jr, J.D.; Bordin, S.; Curi, R.; Carvalho, C.R.O. 2017. *Uncaria tomentosa* improves insulin sensitivity and inflammation in experimental NAFLD. *Scientific Reports*, 8. DOI: http://dx.doi.org/10.1038/s41598-018-29044-y

Ayukekbong, J.A.; Ntemgwa, M.; Atab, A.N. 2017. The threat of antimicrobial resistance in developing countries causes and control strategies. *Antimicrobial Resistance & Infection Control*, 6(47). DOI: http://dx.doi.org/10.1186/s13756-017-0208-x

Azevedo, B.C.; Roxo, M.; Borges M.C., Peixoto H., Crevelin E.J., Bertoni B.W., Contini S.H.T., Lopes A.A.; França, S.C.; Pereira, A.M.S. and Wink, M. 2019. Antioxidant activity of an aqueous leaf extract from *Uncaria tomentosa* and its major alkaloids mitraphylline and isomitraphylline in *Caenorhabditis elegans*. *Molecules*, 24 (18): 3299. DOI: http://dx.doi.org/10.3390/molecules24183299

Bendich, A. 1993. Physiological role of antioxidants in the immune system. Symposium: Antioxidants, immune response and animal function. *Journal of Dairy Science*, 76(9) :2789-2794

Bilandžić, N.; Božić, D.; Kolanović, S. K.; Varenina, I.; Cvetnićb, L.; Cvetnićb Z. 2015. Distribution of sulfamonomethoxine and trimethoprim in egg yolk and withe. *Food Chemistry,* 278: 32-37. DOI: http://dx.doi.org/10.1016/j.foodchem.2015.01.076

Boostani, A.; Sadegui, A.; Mousavi, S.N.; Chamani, M.; Kashan, N. 2015. Effect of organic, inorganic and nano-Se on growth performance, antioxidant capacity, cellular and humoral immune response in broiler chicken exposed to oxidative stress. *Livestock science*, 178:330-336. DOI: https://doi.org/10.1016/j.livsci.2015.05.004

Cala, D.L.; Kochenborger, J.B. 2015. *Suplementacao de una-de-gato (Unacria tomentosa) en dietas para tilapias-do-Nilo e acará-bandeira (Pterophyllum scalare)*. Tesis de Maestría. Sao paulo: Universidad Estadual Paulista.

Dominguez, A.; Sartori, A.; Valente, L M.; Golim, M.A.; Siani, A.C.; Viero, R.M. 2011. *Uncaria* *tomentosa* Aqueous-ethanol extract triggers an immunomodulation towards Th2 cytokine profile. *Phytotherapy Research*, 25(8): 1229-1235. DOI: http://dx.doi.org/10.1002/ptr.3549

Dreosti, I.E. 2000. Antioxidant polyphenols in tea, cocoa and wine. *Nutrition*, 16 (7-8):692-694. DOI: http://dx.doi.org/10.1016/S0899-9007(00)00304-X

Dreifus, A.A.; Bastos-Pereira, A.L.; Avila, T.V.; Da Silva, B.; Rivero, A.J.; Aguilar, J.L.;Acco, A. 2010. Antitumoral and antioxidant effects of a hidroalcoholic extract of cat's claw (*Uncaria tomentosa*) (Willd Ex Roem & Schult) in an in vivo carcinoma sarcoma model. *Journal of Etnopharmacology,* 130 (1): 127-133. DOI: http://dx.doi.org/10.1016/j.jep.2010.04.029

El-Saber, G.; Beshbishy, A.M.; Wasef, L.; Elewa, Y.H.A.; Abd, M.A.; Taha, A.E.; Abdullah, A.; Devkota, H.P. and Tufarelli, V. 2020. *Uncaria tomentosa* (Willd. ex-Schult.) DC.: A Review on chemical constituents and biological activities. *Applied Science*, 10(18), 2668 http://dx.doi.org/10.3390/app10082668

Evans, E.; Duncan, R. 2005. *Proteínas, lípidos y carbohidratos. Patología clínica veterinaria*. Barcelona Multimedia ediciones veterinarias. p. 199- 235.

Flees, J.; Greene, E.; Gangul, B.; Dridi, S. 2020. Phytogenic feed and water-additives improve feed efficiency in broilers via modulation of (an)orexigenic hypothalamic neuropeptide expression. *Neuropeptides*, 81:102005. DOI: http://dx.doi.org/10.1016/j.npep.2020.102005

Gerasopoulos, K.; Stagos, D.; Kokkas, S.; Petrotos, K.; Kantas, D.; Goulas, P.; Kouretas, D. 2015. Feed supplement with byproducts from olive oil mil wastewater processing increases antioxidant capacity in broilers chicken. *Food and Chemical Toxicology,* 82:42-49. DOI: http://dx.doi.org/10.1016/j.fct.2015.04.021

Halliwell, B. 1994. Free radicals and antioxidants: A personal view. *Nutrition Reviews,* 52(8): 253-265. DOI: http://dx.doi.org/10.1111/j.1753-4887.1994.tb01453.x.

Hou, J.; Long, X.; Wang, X.; Li L.; Mao, D.; Luo, Y.; Ren, H. 2023. Global trend of antimicrobial resistance in common bacterial pathogens in response to antibiotic consumption. *Journal of Hazardous Materials,* 442: 130042. DOI: http://dx.doi.org/10.1016/j.jhazmat.2022.130042

Ibrahim, K.E.; Al-Ashban and Al-Sammani, S. A. A. 2009. Study of the toxicity of cat´s claw herbal medicine. *Research Journal of Pharmacology*, 3(3): 52-57.

Jahanian, R.; Mirfendereski, E. 2015. Effect of high stocking density on performance, egg quality, and plasma and yolk antioxidant capacity in laying hens supplemented with organic chromium and vitamin C. *Livestock Science,* 177:117-124. DOI: http://dx.doi.org/10.1080/09712119.2020.1824919

Jechalke; S.; Heuer, H.; Siemens, J.; Amelung, W.; Smalla, K. 2014. Fate and effects of veterinary antibiotics in soil. *Trends in Microbiology*, 22(9): 536-545. DOI: http://dx.doi.org/10.1016/j.tim.2014.05.005

Jia-Hao, L.; Wang, C.; Xiao-Kui, H.; Xiang-Ge, T.; Wen-Yu, Z.; Wang, X.; Cheng-Peng, S.; Xiao-Chi, M. 2020. The genus *Uncaria*: A review on phytochemical metabolites and biological aspects. *Phytotherapy*, 147:104772. DOI: http://dx.doi.org/10.1016/j.fitote.2020.104772

Kimera, Z.I.; Mshana, S.E.; Rweyemamu, M.M.; Mboera, L.E.G.; Matee, M.I.N. 2020. Antimicrobial use and resistance in food producing animals and the environment: an African perspective. *Antimicrobial Resistance and Infection Control*, 9(37). DOI: http://dx.doi.org/10.1186/s13756-020-0697-x

Li, R.; Cheng, J.; Jiao, M.; Li, L.; Guo, C.; Chen, S.;

Liu, A. 2017. New phenylpropanoid-substituted flavan-3-ols and flavonols from the leaves of *Uncaria rhynchophylla*. *Fitoterapia*, 116:17-23. DOI: http://dx.doi.org/10.1016/j.fitote.2016.11.005

Martínez, V.; Periago, M.; Rios, G. 2000. Significado nutricional de los compuestos fenólicos de la dieta. *Archivos latinoamericanos de nutrición*, 50(1): 5-15.

Méndez, P.; Ponce, F.; Fraga, D.; Pípole, F.; Perazzo, F.F.; Hueza, I. 2014. High doses of *Uncaria tomentosa* (cat's claw) reduces blood glucose levels in rats. *International Journal of Pharmacy and Pharmceuticual Science*, 6(2): 410-415.

Miranda, M. 2002. *Métodos de análisis de drogas y extractos*. Universidad Nacional Ciudad de la Habana, CUBA. 68pp.

Muloi, D.; Ward, M.J.; Pedersen, A.B.; Fe`vre, E.M.; Woolhouse, M.E.J.; van Bunnik B.E.D. 2018. Are Food Animals Responsible for Transfer of Antimicrobial-Resistant *Escherichia coli* or Their Resistance Determinants to Human Populations? A Systematic Review. *Foodborne Pathogens and Disease*, 15 (8):467-474. DOI: http://dx.doi.org/10.1089/fpd.2017.2411

Murugesan, G.R.; Syed, B.; Haldar, S.; Pender, C. 2015. Phytogenic feed additives as an alternative to antibiotic growth promoters in broiler chickens. *Frontiers in Veterinary Science*, 2:21 DOI: http://dx.doi.org/10.3389/fvets.2015.00021

Navarro, M.; Arnaez, E.; Moreira; I.; Hurtado, A.; Monge, D.; Monagas, M. 2019. Polyphenolic Composition and Antioxidant Activity of *Uncaria tomentosa* Commercial Bark Products. *Antioxidants* 8(9):339. DOI: http://dx.doi.org/10.3390/antiox8090339

Navarro, M.; Sánchez-Patán, F.; Murillo, R.; Martín-Álvarez, P.J.; Zamora, W.; Monagas, M.J.; Bartolomé, B. 2015. Phenolic assessment of *Uncaria tomentosa* l. (cat's claw): leaves, stem, bark and wood extracts. *Molecules*, 20(12): 22703–22717. DOI: http://dx.doi.org/10.3390/molecules201219875

Navarro-Hoyos, M.; Lebrón-Aguilar, R.; Quintanilla-López, J.E.; Cueva, C.; Hevia, D.; Quesada, S.; Azofeifa, G.; Moreno-Arribas, M.V.; Monagas, M.; Bartolomé, B. 2017. Proanthocyanidin characterization and bioactivity of extracts from different parts of *Uncaria tomentosa* l. (cat's claw). *Antioxidants*, 6(1):12. DOI: http://dx.doi.org/10.3390/antiox6010012

Obregón, L. 1997. *Uña de gato", genero Uncaria. Estudios botánicos, químicos y farmacológicos de Uncaria tomentosa y Uncaria guianensis.* 3 Ed. Lima: Instituto de Fitoterapia Americano. 169 pp.

Ogbuewu, I.P.; Mokolopi, B.G.; Mbajiorgu, C.A. 2022. Meta-analysis of growth performance indices of broiler chickens in response to turmeric (*Curcuma longa* L.) supplementation. *Animal Feed Science and Technology*, 283. DOI: https://doi.org/10.1016/j.anifeedsci.2021.115155

Oloso, N.A.; Fagbo, S.; Garbati, M.; Olonitola, S.O.; Awosanya E.J.; Aworh, M.K.; Adamu, H.; Odetokun, I.A.; Fasina, F.O. 2018. Antimicrobial Resistance in Food Animals and the Environment in Nigeria: A Review. *International Journal of Environment Research and Public Health*, 15(6):1284. DOI: http://dx.doi.org/10.3390/ijerph15061284

Paredes-López, D.; Robles-Huaynate, R.; Sandoval-Cueva, C.; Sandoval-Chacón, M. 2018. Effect of *Uncaria tomentosa* aqueous extract on biochemical and hematological profiles and live performance parameters in broiler chickens. *Livestock Research for Rural Development*, 30 (5): 78

Paredes-López, D.; Robles-Huaynate, R.; Mendoza-Isla, D.; Mendoza-Pérez, C.

Saavedra-Rodríguez, H. 2019. Effect of the ethanolic extract of *Dracontium spruceanum* rhizome on hematologic, biochemical profiles and performance parameters of broiler chickens. *Scientia Agropecuaria*, 9(3):411-416. DOI: https://doi.org/10.17268/sci.agropecu.2018.03.12

Paredes-López, D.M., Robles-Huaynate, R., Beteta-Blas, X. Aldava-Pardave, U. 2023. Effect of *Morinda citrifolia* fruit powder on physiological and productive performance of *Cavia porcellus*. *Frontiers in Veterinary Science*, 10: 1134138. DOI: https://doi.org/10.3389/fvets.2023.1134138

Paredes-López, D.M., Robles-Huaynate R.A., Vásquez-Soto, M.R.; Perales-Camacho, R.A.; Morales- Cauti, M.S.; Beteta-Blas, X.; Aldava-Pardave, Uriel. 2024. Modulation of gut microbiota and morphometry, blood profiles, and performance of broiler chickens supplemented with *Piper aduncum, Morinda citrifolia,* and *Artocarpus altilis* leaves ethanolic extracts. *Frontiers in Veterinary Science*, 11: 1286152. DOI: http://dx.doi.org/10.3389/fvets.2024.1286152

Pilarski, R.; Zielinski, H.; Ciesiolka, D. and Gulewicz, K. Antioxidant activity of ethanolic and aqueous extract of *Uncaria tomentosa*. (Willd.) DC. 2006. *Journal of Etnopharmacology,* 104: 18-23. DOI: http://dx.doi.org/10.1016/j.jep.2005.08.046

Quijano-Rojas, E. 2016. *Uso del extracto hidroalcohólico de hojas de uña de gato (Uncaria tomentosa), sobre perfiles bioquímicos, constantes hematológicas y parámetros productivos en pollos de carne en etapa de inicio*. Tesis de pregrado, Universidad Nacional Agraria de la Selva, Tingo María, Perú. 59pp.

Reece, W. 2015. The composition and functions of blood. En: Reece, W.O.; Erickson, H.H.; Goff, J.P.; Uemura, E.E. (Eds) *Duckes' Physiology of Domestic Animals*. 13th Edition, Wiley Blackwell, OX, UK. p. 114-136

Rojas-Durand, R., Gonzáles-Aspajo, G.; Ruiz-Martel, C.; Bourdy, G.; Doroteo-Ortega, V.H.; Alban-Castillo, J.; Robert, G.; Auberger, P.; Dejaro, E. 2012. Anti-inflmmatory activity of mitraphylline isolated from *Uncaria tomentosa* bark. *Journal of Enthnopharmacology*, 143(3):801-804. DOI: http://dx.doi.org/10.1016/j.jep.2012.07.015

Romero, R. 2012. *Cuantificación de Polifenoles en hojas de uña de gato Uncaria tomentosa (Willd. ex Schult) DC provenientes de tres localidades en Ucayali.* Tesis de pre-grado. Facultad de Forestales, Universidad Nacional Agraria la Molina. Lima-Perú. 107 pp.

Rostagno, H.; Albino, L.; Donzele, J.; Gomes, P.; de Oliveira, R.; Lopez, D.; Ferreira, A.; Barreto, S.; Euclides, R. 2017.*Tablas Brasileñas para aves y cerdos. Composición de alimentos y requerimientos nutricionales*. 3ª Edición. Universidad Federal de Viçosa–Departamento de Zootecnia. 259pp.

Saavedra, H. 2008. *Uso de uña de gato Uncaria sp en la etapa de acabado de pollos parrilleros.* Tesis de pre-grado. Universidad Nacional Agraria de la Selva. Tingo María, Perú. 38pp.

Sakai, N.; Sakai, M.; Mohamad Haron, D.; Yoneda, M.; Mohd, M. 2016. Beta agonists residues in cattle, chicken and swine livers at the wet market and the environmental impacts of wastewater from livestock farmers in Selangor state, Malaysia. *Chemosphere*, 165:183-190. DOI: http://dx.doi.org/10.1016/j.chemosphere.2016.09.022

Samour, J.; Silvanose, C.; Pendl, H. 2016. Clinical and diagnostic procedures. En: Samour, J. *Avian Medicine*. 3ed Edition, Mosby, 324:477 DOI: http://dx.doi.org/10.1136/bmj.324.7335.477.

Sandoval, C. 2012. *Capacidad Antioxidante del extracto atomizado de uña de gato (Uncaria tomentosa) y efecto sobre los perfiles* *bioquímicos sanguíneos, constantes hematológicas y parámetros productivos en pollos de carne.* Tesis de pregrado. Universidad Nacional Agraria de la Selva, Tingo María. Huánuco-Perú. 79pp.

Sandoval, M.; Charbonnet, R.; Miller, M. 1998. Cytoprotective effects of resveratrol against oxidative stress. *Free radical biology y medicine*, 7(10): 147. DOI: http://dx.doi.org/10.3390/antiox7100147

Sandoval-Chacón, Thompson, Zhang, Liu, Mannick, Sadowska-Krowicka, Charbonnet, Clark, Miller. 2002. Anti-inflammatory actions of cats claw: the role of NF- kB. *Aliment Pharmacology Therapy.* 12:1279-1289. DOI: http://dx.doi.org/10.1046/j.1365-2036.1998.00424.x

Servicio Nacional de Meteorología e Hidrología (SENAMHI). 2021. *Promedio de temperatura y precipitación normal para Tingo Maria*. (https://www.senamhi.gob.pe/?p=pronostico,detalle&dp=10&localidad=0025) Acceso: 15/08/2024

Skoufos, I.; Bonos, E.; Anastasiou, I.; Tsinas, A.; Tzora, A. 2020. Effects of phytobiotics on health or disease challenged animals. *Feed Additives*, 311-337. DOI: http://dx.doi.org/10.1016/B978-0-12-814700-9.00018-2

Software Statistics Infostat. 2017. Cordova, Argentina

Soltani, M.; Tabeidian, S.; Ghalamkari, G.; Adeljoo, A.; Mohammadrezai, M.; Saheb Fosoul, S. 2016. Effect of dietary extract and dried aerial parts of *Rosmarinus officinalis* on performance, immune response, and total serum antioxidant activity in broiler chicken. *Asian Pacific Journal of tropical disease*, 6(3): 218-222. DOI: http://dx.doi.org/10.1016/S2222-1808(15)61017-9

Soni, K.; Jyoti, Km.; Chandra, H.; Chandra, R. 2022. Bacterial antibiotic resistance in municipal wastewater treatment plant; mechanism and its impacts on human health and economy. *Bioresource Technology Reports*, 19: 101080. DOI: http://dx.doi.org/10.1016/j.biteb.2022.101080

Sugiharto, S. 2016. Role of nutraceuticals in gut health and growth performance of poultry. *Journal of the Saudi Society of Agricultural Science*, 15: 99-111. DOI: http://dx.doi.org/10.1016/j.jssas.2014.06.001

Tiseo, K.; Huber, L.; Gilbert, M.; Robinson, T.P. and Van Boeckel, T.P. 2020. Global Trends in Antimicrobial Use in Food Animals from 2017 to 2030. *Antibiotics*, 9(12):918. DOI: http://dx.doi.org/10.3390/antibiotics9120918

Tomazelli, O.; Kuhn, F.; Mendonça, P.J.; Mota, L.R.; da Costa, S.W. and Corrêa, B. 2018. Survival of White Spot Syndrome Virus–Infected *Litopenaeus vannamei* Fed with Ethanol Extract of *Uncaria tomentosa*. *Journal of the World Aquaculture Society*, 49(1):165-174. DOI: http://dx.doi.org/10.1111/jwas.12483

Valdiviezo-Campos, J.E.; Blanco-Olano, C.; Olascuaga-Castillo, K.; Rubio-Guevara, S. 2020. *Uncaria tomentosa* (Willd.) DC. (Rubiaceae): Especie nativa del Perú, medicamento herbolario reconocido por la medicina tradicional. *Ethnobotany Research and Applications*, 19: 1-15. DOI: http://dx.doi.org/10.32859/era.19.13.1-15

Vargas-Arana, G.; Merino-Zegarra, C.; Maytahuari-Aricari, G.; Ochoa-Ipushima, M. 2022. Valor nutricional y capacidad antioxidante de cuatro frutos de palmeras nativas de la Amazonía peruana. *Folia Amazonica*, 31 (1): 17-29 . DOI: http://dx.doi.org/10.24841/fa.v31i1.557

Yunis-Aguinaga, J.; Claudiano, G.S.; Marcusso, P.F.; Gómez, W.; Egrácia de Moraes, J.R.; de Moraes, F.R.; Fernández, J.B.K. 2015. *Uncaria tomentosa* increases growth and immune activity in *Oreochromis niloticus* with *Streptococcus agalacteae*. *Fish & shellfish* *immunology*, 47(1):630-638. DOI: http://dx.doi.org/10.1016/j.fsi.2015.09.051

Zalewska, M.; Błazejewska, A.; Czapko, A.; Popowska, M. 2021. Antibiotics and antibiotic resistance genes in animal manure-consequences of its application in agriculture. *Frontiers in Microbiology*, 29(12): 610656. DOI: http://dx.doi.org/10.3389/fmicb.2021.610656

Zhang, Q; Zhao, J.J.; Xu, J.; Feng, F.; Qu, W. 2015. Medicinal uses, phytochemistry and pharmacology of the genus *Uncaria*. *Journal of Ethnopharmacology*, 173: 48-80. DOI: http://dx.doi.org/10.1016/j.jep.2015.06.011

Recibido: 02 de setiembre de 2024 **Aceptado para publicación:** 02 de diciembre de 2024