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Effect of Hibiscus sabdariffa Calyx (Zobo) on the Growth Performance of Broilers (Obamarshal) Chickens

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Abstract
Roselle (*Hibiscus sabdariffa*) is a leaf use to make a drink locally known as zobo. The seed is considered an excellent feed for chicken because of the presence of certain vitamins especially vitamin C which is known for its antioxidant property hence stimulating the immune system. Farmers are constantly seeking for cheaper and healthier means to improve the quality of meat and weight of broilers. Also cheap and readily available synthetic drugs including antibiotics that were used as growth promoters have been banned due to their side effect in both poultry and human health. Many attempts have been made locally by farmers to use natural plant as supplements for birds to replace synthetic antibiotics. There is also a significant lack of knowledge about the beneficial effect of *Hibiscus sabdariffa* in poultry. Although other supplements such as anise seed (pinpinell anisume)have been used to improve meat characteristics and carcass weight, there is a suggestion that calyxes of roselle (zobo) may be used as best alternative. The study aims to test the effect of feeding different level of "zobo" in drinking water on the growth performance of broilers.Fifty day old broilers were sourced and exposed to the same feeding, watering and other management conditions like vaccinations and treatment until they were 4 weeks old. They were then divided into groups of 10 and treated with different concentrations of roxelle calyx gotten from water and ethanol extraction. The groups were A1 (broiler chicks on 1g/4l water extract of roselle calyx), A2 (broiler chick on 1g/4L ethanol extract of roselle calyx), B1 (broiler chick on 2g/4L water extract of roselle calyx), B2 (broiler chick on 2g/4L ethanol extract of roselle calyx) and C which were the control (broilers on plain water). Rectal temperatures were taken every Mondays, Wednesdays and Fridays in the mornings and evenings. Live weight, carcass weight, dislocated carcass weight, internal organs and feed intake were the response criteria used when broilers were 8 weeks old. The birds (A2) on *Hibiscus sabdariffa* had the highest weight gain and consumed the largest quantity of feed as compared to control. This was statistically significant ($P<0.05$). It can be concluded from this study that roselle calyx (zobo) tends to enhance weight gain, feed consumption and conversion in broilers.
Keywords: Roselle calyx, zobo, water extract, ethanol extract, weight gain.

INTRODUCTION

ROSELLE (Hibiscus Sabdariffa)

Herbs and their extract have been used widely in poultry nutrition as an antimicrobial, antioxidant and a natural growth promoter. Roselle (*Hibiscus sabdariffa*) is a leaf used to make a drink locally known as zobo, this is a red colored flower (calyx of *Hibiscus sabdariffa.*The vegetable is widely grown in northern part of Nigeria. Tribes such as Hausas call the plant yakuwa and the seed isontea while the fresh calyx is referred to as zoborodo, the leaves are called Amukan and the flowers ishapa by the Yoruba tribe (www.nigerianbestforum.com).

Types

There are two main types of *Hibiscus sabdariffa.* The economically useful one is H.sabdariffa var altissima. It is erect, sparsely branched, an annual crop, 4.8m high and its cultivated for its jutelike fibre in India, East indies, Nigeria and to some extent in tropical America. It's stems are green, the leaves are also green sometimes with red veins. It's flowers are yellow and the calyxes are red and green, non fleshy, spiny and not used for food. The other type is *H. sabdariffa* var *sabdariffa,* which is found in shorter, bushy forms (Okereke *et al*., 2015).

Health Attributes/Uses

Roselle was used to lower blood pressure to the normal level. Al- obeidy (2008) reported that roselle flower contains vitamin C (about 45-50mg/100mls solution in addition, it contains citric acid (3-4%) which plays an important role on gut flora and then enhances nutrient absorption. The roselle plant is considered an antiseptic, emollient, sedative and tonic (Olaleye, 2007).It aids digestion, promotes kidney function, improves cardiovascular health and helps reduce fever (Fasoyiro *et al*., 2005; Al – Wandawl *et al*., 1984). The seed is considered an excellent feed for chicken, the residue after oil extraction is valued as cattle feed. A yellow dye obtained from the petal is used in medicine; the seed yield 20% oil with properties similar to cotton seed oil (Bol Salleh, 1999).

Amino Acid Composition

Arginine 3.6mg, Cystine 1.3mg, Histidine 1.5mg, Isoleucine 3.0mg, Leucine 6.0mg, Lysine 3.9mg, Methionine 1.0mg, Phenylalanine 3.2mg, Threonine 3.0mg, Tyrosine 2.2mg, Valine 3.0mg, Aspartic acid 16.3mg, Glutamic acid 7.2mg, Alanine 3.7mg, Glycine 3.8mg, Serine 3.5mg (Adanlawo and Ajibade, 2006).

Nutritive and Chemical Composition (Adanlawo and Ajibade, 2006).

Composition	**food value in gramme /100mg of fresh calyxes**
Moisture	9.2
Protein	1.14
Fat	2.01
Fibre	12.0
Ash	6.90
Calcuim	1.26
Phosphorus	0.2372
Iron	8.98mg
Carotene	0.0029mg
Thiamine	0.0117mg
Riboflavin	0.277mg
Niacin	3.765mg
Ascorbic acid	6.9mg

Scientific Classification of *Hibiscus sabdariffa* (Zobo)

Kingdom	Plantae
Order	Malvales
Family	Malvaceae
Genus	*Hibiscus*
Species	*sabdariffa*
Botanical name	*Hibiscus sabdariffa*

In Nigeria, the cultivation of *Hibiscus sabdariffa* is steadily expanding due to increasing demand for its calyxes which are used for zobo drink and soup. (Ibrahim *et al*., 2010 and Adigun, 2003). Many attempts have been made to use natural plant instead of antibiotics such as herbs which have properties as growth enhancers to replace synthetic antibiotics (Abaza, 2001). Al- Herthi (2002) and El- Husseiny *et al*., (2002) showed an improvement in nutrient digestibility of broiler diet using medicinal plant mixtures among these plants is roselle (*Hibiscus sabdariffa)* which has been used to combat a variety of ailment and is a popular herb widely used to combat a variety of ailment and is a popularly used spice in some countries.It is therefore conceivable that the consumption of the extract may provide natural agent against oxidative damage and other free radical induced condition (Harmann, 1984; Wilff *et al*., 1986).

The roselle calyx is used to supplement synthetic antibiotics in drinking water of broiler as farmers continuously source for alternative ways to improve the quality of meat and weight of broilers. Many countries have banned the use of synthetic drugs including antibiotics as growth promoters due to their side effect on both poultry and human health (Heitzman, 1986; Khacha, 1988).This has necessitated the need for alternative supplements to enhance growth. It has been documented that roselle extracts are characterized by a very low degree of toxicity. The lethal dose (LD_{50}) of *Hibiscus sabdariffa* calyx extract in rats were found to be above 5000mg/kg (Ali *et al*., 2005; Mohammed *et al*., 2007). The conventional raw materials for poultry feed such as soya beans, groundnut cake and fishmeal are scarce and expensive because they are competed for, by humans as food and for other industrial uses (Kwari *et al*., 2011). As a result, supplementing broiler diet with some feed additive maybe considered as an alternative to improve growth, health and feed conversion efficiency. Several supplements such as anise seed (pinpinell anisume) have been used to improve meat characteristics and carcass weight. There is a suggestion that calyxes of roselle may be the best alternative (Hamodi and Al-Khalani, 2011).

AIM

The study is to determine the effect of feeding different level of "zobo" supplementation in drinking water on the growth performance of broilers.

OBJECTIVES

To determine,

i. The life weight of the bird at maturity (56 days) through weighing experimental birds and comparing with the weight of control birds.
ii. The carcass weight of experimental birds and compare with that of control.
iii. The weight of internal organs and dislocated carcasses of experimental and compare with control birds.

RESEARCH QUESTION

i. Are the life weight of experimental birds higher than the weight of control birds*?*
ii. Are the carcass weight of experimental birds higher than the weight of control birds?

iii Are the weight of the internal organs and dislocated carcasses of experimental birds higher than the weight of control birds?

Null Hypothesis: There is no difference in mean weight of broilers served *Hibiscus sabdariffa* in drinking water and weight of broilers served water only.

2.0 (MATERIALS AND METHODS)

2.1 STUDY AREA

The study was conducted at the college of Agriculture and Animal Science (CAAS), Ahmadu Bello University, Mando, Kaduna State, Nigeria. The sample birds were sourced from Obasanjo farms within Kaduna metropolis.

Housing

The chicks were raised in a standard deep litter system up to 8 weeks (56 days).The poultry house and materials to be used were fumigated and disinfected using formalin, pottasuim permanganate and dettol. On arrival of the birds, solution of glucose and vitamins was given to serve as anti-stress. The birds were fed known quantity of feed by 7:00am and 5pm daily while left over was weighed to get actual quantity of feed consumed daily.

2.2 Study Design

A total number of 50 day old broiler chicks were used, after 4 weeks of adoption period the birds were divided into 3 groups, A, B and C. Groups A and B were further subdivided into A1, A2, B1 and B2 while group C was the control.

Group A1 and B1 were treatment group with water extract of roselle calyxe. Group A2 and B2 were treatment group with ethanol extract of roselle calyxe while Group C were given ordinary water. The amount of feed consumed daily were measured using weighing scale at 7:00 am daily and recorded. At 8 weeks the birds were randomly picked from each group and the following parameters were taken: Life weight, carcass weight, dislocated carcass, internal organs weight and feed intake.

Administration of Zobo

Administration started when birds were 4 weeks old, the roselle calyx extract was given orally in water, group A1 were served 1g of water extracted dried roselle calyx to 4 litres of water, A2 were served 1g of ethanol extracted dried roselle calyx to 4 litres of water, B1 were served 2g of water extracted dried roselle calyx to 4 litres of water, and B2 were served 2g of ethanol extracted dried roselle calyx to 4 litres of water while the control (C) group were given water only. The extracts were administered daily and the birds were observed over 24 hours on the first day for signs of toxicity including behavioural changes and death. The study was concluded after 4 weeks of roselle calyx administration.

Measurement of Weight

The weight of the bird were taken weekly up to the last day of experiment, initially 5 birds were randomly selected and weighed using weighing scale and the average weight were taken but as the birds grew older, each bird was weighed using the weighing scale. The carcass weights, dislocated carcass, weight of internal organs were all taken in the laboratory using the digital weighing scale.

Rectal Temperature

The rectal temperature was measured twice daily (7:00am and 5:00pm) on Monday, Wednesday and Friday using a sterile thermometer the bulb was gently inserted into the rectum and slanting sideways for about 1-2 minutes.

Extraction Procedure

Dried roselle calyxes were obtained from market and was grinded into powder with mortar and pestle.Two methods of extraction were carried out: Ethanolic extraction and Water Extraction.

Ethanolic Extraction: The extract of the active zobo leaves were carried out using method as described by Harbone, 1984. 200g of the grinded leaves were soxhlet extracted using 250mls of 95% ethanol. The extraction lasted for 6hours.The volatile oil obtained was concentrated by evaporating using water bath at 100° C.

Water Extraction: The method of Akujibi *et al.,* 2004 was adopted using 200g of grinded leaves which was soxhlet extracted using 250mls of distilled water, the extraction lasted for 6 houre.The filtrate obtained was concentrated on a water bath at 100°C.

Statistical Analysis

Data obtained on live weight and carcass weight were analysed using Statistical package for Social Sciences (SPSS) version 17.0 (SPSS Inc. Chicago, IL, USA) .Statistical methods employed included descriptive statistics using percentages, tables and graphs. Student t-test was used to establish association between variables. Values of P less than 0.05 were considered significant.

PHYTOCHEMICAL SCREENING OF *HIBISCUS SABDARIFFA* (ZOBO)

	Test	Observation	Water extract	Ethanol extract
1	1ml of extract +few drops of 0.1% ferric chloride	Brownish green or blue black color	+++ tannin present	+++ tannin present
2	1ml of extract boiled in 1% aqeous hydrochloric acid	No visible color	- Phlobotanin absent	- Phlobotanin absent
3	1-2 ml of extract + 5ml of distilled water, shake vigorously for stable persistent froth, frothing was mixed with 3 drops of olive oil and shaken vigorously	Emulsion was formed	+++ Saponin present	+ Saponin present
4	1ml of extract + 1ml of dilute ammonia solution + a drop of concentrated H_2SO_4	Yellow coloration forms and disappear on standing	++ Flavonoid	- Flavonoid
5	0.5ml of ethanolic extract + 1ml acetic acid + 1ml H_2SO_4	Violet to blue or green coloration	+ steroid present	-Steroid absent
6	0.5ml of extract + 1ml of chloroform +1.5ml of concentrated H_2SO_4 added carefully to form layers	Reddish brown coloration of the water face.	+ terpenoid present	-terpenoid absent
7	0.5ml of extract + 1ml of acetic acid + 1 drop of ferric chloride solution + lml of concentrated H_2SO_4 gently on the side of the test tube.	Brown ring was formed at water face and acetic acid layer greenish	++ cardiac glycoside present	+ cardiac glycoside present
8	Re-extracted with 10ml carbon tetrachloride ,carbon tetrachloride layer was removed then washed with 5ml of water, then addition of dilute ammonia solution	Pink to red ammoniacal layers were formed	++ anthraquinone present	++ anthraquinone present
9	1ml of filtrate, a few drops of drangendart reagent was added	Turbidity or precipitate	+ alkaloid present	-alkaloid absent

RESULTS

Hibiscus sabdariffa had effect on live weight of the broilers from the time of its administration to the end (week 5 to week 8) (TABLE1). At 8 weeks, group A2 had the highest weight gain(before and after slaughter) and feed intake (TABLE2, 3 and 4) compared to groups A1, B1, B2 and control (TABLE 2,).Groups A2 also showed the highest mean score on carcass weight compared to groups A1,B1 and B2 and control (TABLE 5). The effect of HBS calyx on the internal organs is displayed on TABLE 6.

Table 1: Effect of *Hibiscus sabdariffa* on broiler: average weight from week 4 to week 8

	TREATMENTS				
Parameter	**C**	**A1**	**A2**	**B1**	**B2**
Avg weight (kg) week 4	0.60^b	0.54^a	0.60^b	0.60^b	0.62^b
Avg weight (kg) week 5	0.90^a	1.00^b	1.00^b	0.90^a	0.90^a
Avg weight (kg) week 6	1.40^a	1.50^b	1.50^b	1.60^c	1.40^a
Avg weight (kg) week 7	1.70^a	1.90^b	1.70^a	2.20^c	1.90^b
Avg weight (kg) week 8	1.96^a	2.34^b	2.60^c	2.20^b	2.24^b

Values in the same row having the same superscripts are not significantly different (P>0.05)

Effect of *Hibiscus sabdariffa* on live weight of broilers at 8 weeks (56days)

Table 2: Comparism of weights of control and treatment groups using student t-test

Treatment groups and control	N	X	SD	SEM	df	t-cal	P-value	Decision
A1 (1kg of water extract)	5	2.34	0.19	0.09	8	2.0548	2.306	p>0.05 H_oRt
A2 (1kg of ethanol extract)	5	2.60	0.12	0.05	8	3.7199	2.306	p<0.05H_oRj
B1 (2kg of water extract)	5	2.20	0.31	0.99	8	1.1118	2.306	p>0.05 H_oRt
B2 (2kg of ethanol extract)	5	2.24	0.19	0.09	8	-1.5141	2.306	p>0.05 H_oRt
Control (plain water)	5	1.96	0.36	0.16				

Effect of *Hibiscus sabdariffa* on body weight of broilers after slaughter at 8 weeks (56days)

Table 3: Comparism of the average weight of control and treatment groups using student t-test.

Treatment groups and control	N	X	SD	SEM	df	t-cal	P-value	Decision
A1 (1kg of water extract)	5	2.06	0.19	0.08	8	-1.249	2.306	p>0.05 H_oRt
A2 (1kg of ethanol extract)	5	2.36	0.13	0.05	8	3.0187	2.306	p<0.05H_oRj
B1 (2kg of water extract)	5	2.12	0.33	0.14	8	-1.331	2.306	p>0.05 H_oRt
B2 (2kg of ethanol extract)	5	2.06	0.20	0.08	8	-1.2477	2.306	p>0.05 H_oRt
Control (plain water)	5	1.82	0.37	0.16				

Effect of *Hibiscus sabdariffa* on feed consumption (kg)

Table 4: Average feed intake (kg) of control and treatment groups (for each group number of birds n, was 10)

	TREATMENTS				
Parameter	**C**	**A1**	**A2**	**B1**	**B2**
Avg feed intake(kg)week 5	6.42^a	7.20^b	7.80^c	6.30^a	6.78^a
Avg feed intake(kg)week 6	6.30^a	7.80^b	9.20^c	7.80^b	9.90^c
Avg feed intake(kg)week 7	8.70^a	9.10^b	12.50^c	8.80^a	10.10^c
Avg feed intake(kg)week 8	9.70^a	9.00^b	11.80^c	9.20^a	11.30^c
Total feed intake(kg)	30.82^a	33.10^a	41.30^b	32.1^a	38.08^b

Values in the same row having the same superscripts are not significantly different (P>0.05)

Table 5: Effect of *Hibiscus sabdariffa* on weight of broilers carcass (g) (n= 5 for each group)

	TREATMENTS				
Parameter	**C**	**A1**	**A2**	**B1**	**B2**
Breast	348.96^a	429.09^b	502.91^c	454.24^b	438.24^b
Thigh	211.56^b	253.69^a	285.72^c	224.79^b	240.30^a
Neck	117.04^a	123.31^a	148.52^c	106.89^b	113.15^b
Wing	79.79^c	99.22^a	113.23^b	99.20^a	99.33^a
Back	257.34^a	305.99^d	368.50^c	319.19^b	320.04^b

Values in the same row having the same superscripts are not significantly different (P>0.05)

Table 6: Effect of *Hibiscus sabdariffa* on weight of internal organs of broilers carcass (g) (n= 5 for each group)

	TREATMENTS				
Parameter	**C**	**A1**	**A2**	**B1**	**B2**
Liver	48.5^a	52.23^b	59.65^c	51.97^a	55.03^c
Heart	11.46^a	11.92^c	11.53^a	12.41^d	11.67^b
Gizzard	37.58^a	37.77^a	40.76^b	42.16^c	35.74^a
Abdominal fat	19.88^a	35.63^b	45.05^c	42.35^c	43.36^c
Lungs	12.78^a	14.81^b	17.09^d	14.37^b	13.9^c

Values in the same row having the same superscripts are not significantly different (P>0.05)

DISCUSSION

The increase in live weight observed in chicken that were administered roselle calyx (zobo) suggests that the extract might have increased feed consunmption or contains substances that enhanced growth of broilers. There was a gradual increase in growth of broilers due to roselle calyx (zobo) in all treatment groups (A1, A2, B1 and B2) compared to control. This may have been due to the antioxidant and growth promoting effect of the calyx as a result of the presence of certain amino acids and vitamins (Adanlawo and Ajibade, 2006). The flower is also reported to contain vitamin C which plays an important role in gut microflora and enhances nutrient absorption (Al-obeidy, 2008).

However the effect in live weight gain was more significant in group A2 which were served ethanol extracted roselle calyxes (zobo) with the mean score of 2.60 compared to mean scores of 2.34, 2.24, 2.20 and 1.96 for A1, B2, B1 and C respectively. Ethanol is known to be toxic at a higher concentraton and that was why the birds responded positively to a lower concentration of it. Ethanol extraction gives better yield of the product being extracted compared to water extraction and that maybe the reason why a higher weight gain was observed with ethanol extracted HBS calyx. Also ethanol extracted roselle calyx is known to have a better antibacterial activity (bacteria like salmonella because of the presence of protocatechuic acid which inhibits growth of bacteria like E.coli, fungi and nosocomial bacteria.(Che –Yi and Mei – Chin, 2008).This will help to prevent diseases due to commonly occurring bacteria and consequently boost the immune system, improve feed conversion and weight gain of the birds. There was a statistical significant difference (P<0.05) when control was compared to Group A2 indicating that occurrence of weight gain is associated with administration of ethanol extracted HBS calyx. This increase in weight could be due to the presence of vitamin C in roselle calyx which has a positive effect on cell activity and increases oxygen consumption and as a result stimulates thyroid glands

which play a major role in metabolism (Hamodi and Al-Khalani, 2011).

Feed intake from week 5 to week 8 were 41.30kg, 38.08kg, 33.10kg, 32.10kg and 30.82 kg for A2, B2, A1, B1 and C respectively. The gradation which was in favour of broilers on roselle calyx could be attributed to the high content of vitamin C, protein and minerals in roselle which enhances appetite (Mahadaven and Pradeep, 2009).

CONCLUSION

Mean weights of broilers treated with HBS at 8weeks were 2.34kg, 2.60kg, 2.20kg and 2.24kg compared to 1.96kg of birds that were given only water (control). After slaughter the weight of treated birds were 2.06kg, 2.36kg, 2.12kg and 2.06kg as compared to 1.82kg of the control. There was also an increase in feed intake by treated birds (average feed intake from 5 weeks to 8 weeks was 36.15kg) as compared to 30.2kg by the control birds. Also, weight of internal organs especially offals that are consumed weighed more in treated than untreated birds. This study has shown that replacing antibiotics with roselle calyx in drinking water of broilers improves performance. *Hibiscus sabdariffa* can therefore be considered as a natural growth promoter due to its ability to stimulate digestion.

RECOMMENDATION

There is a lack of knowledge about the beneficial effect of "zobo" as an additive in drinking water of birds (broilers) by local to medium scale farmers. In developing country like Nigeria, these type of farmers are more predominant (about 80%) and they generate a source of livelihood from keeping broilers hence it confers on the health practitioners and poultry experts to disseminate information and enlighten farmers on the economic gains.

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