

INFLUENCE OF COSTUS ROOTS EXTRACT ON PRODUCTIVE PERFORMANCE, PHYSIOLOGICAL RESPONSES AND BACTERIAL COUNT IN WEANING RABBITS

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ABSTRACT:

*The current investigation began at a private rabbitry farm in Qalyubia province, Egypt's during winter season. The study aimed to investigate the *Saussurea lappa* effects on productive performance, digestibility and biochemical blood of weaning rabbits. Sixty male California rabbits, aged 6 weeks and weighing an average of 591.03 ± 11.9 g were divided randomly into four equal treatments. Supplementation of *Saussurea lappa* extract (costus roots) (**SLE**) was supplemented in drinking water for 3 days weekly until 12 weeks of age. **Gp0** group was served as control, while, **Gp1**, **Gp2** and **Gp4** groups were received 100, 200 and 400 mg SLE/kg BW, respectively.*

*Results showed that significant increase ($P \leq 0.05$) in the combined final and gain weights of the *Saussurea lappa* treated group compared to the control and improved FCR. Interestingly, **Gp4** recorded the highest final LBW and the best FCR. Levels of TP, Alb, Glo, AST, and ALT were nearly normal in rabbit's oral receiving water that had been*

*gradually supplemented with an aqueous extract of costus roots. Aqueous extract of costus roots caused a significant reduction ($P \leq 0.05$) in serum TC, TG and LDL-c while, elevated HDL-c. On the other hand, urea and creatinine recorded insignificant levels. *Saussurea lappa* extract oral administration in drinking water significantly boosts the immunoglobulin levels (IgG and IgM), TAC and decreasing MDA and SOD were evident in the *Saussurea lappa* administered rabbits relative to the control group. Antibacterial activity of aqueous extract of costus roots at the three concentrations tested against total bacterial count (TBC), *Salmonella*, *E. coli*, *Proteus* and *Clostridium* was more significant than that of the control group. Interestingly, the antibacterial activity is increased by increasing the concentration of *Saussurea lappa*. However, the **Gp4** recorded a low bacterial count of *E. coli*, *Salmonella*, *Proteus*, and *Clostridia* but a high count of TBC.*

In conclusion, oral administration of *Saussurea lappa* did

not cause any adverse effects on growth performance, serum parameters and effective on bacterial count. Additionally, *Saussurea lappa* had the best profitability (Highest final body weight).

Key words: Costus roots, California rabbits, productive performance, bacterial count and biochemical blood.

INTRODUCTION:

Worldwide interest has been directed towards using natural products containing biologically active compounds. The World Health Organization (WHO) has the aim of investigating all medical plants used globally and has a list of a large number of species (Srivastav *et al.*, 2011). According to the WHO, traditional herbal medicine is used by more than 80% of the world's population for primary health care (Vijayan *et al.*, 2007). For the use of herbs in therapy or medicine, herbal medicine is also referred to as herbalist or botanical medicine (Barens, 2002). According to Arokiyaraj *et al.*, (2007) a large number of these plants, plant extracts, plant derivatives, and/or their isolated constituents have shown beneficial biological effects, including immune-modulator, antioxidant, anti-inflammatory, anti-mutagenic, and anti-microbial effects. Also *Saussurea lappa* has been traditionally used in medicines without obvious adverse effects (Kulsoom *et al.*, 2014).

Among all the species of the genus *Saussurea lappa* (*costus roots*) is one of the most commercially viable. It is widely used in numerous indigenous systems of medicine around the world to cure diarrhea, vomiting, dyspepsia, and inflammation, among other problems (Irshad *et al.*, 2012). Chauhan *et al.*, (2014) describe *Saussurea lappa* (*costus roots*) as an aphrodisiac plant that improves the quality of sperm and has been used as a medicine (Suffredini *et al.*, 1999). Medicinal plants contain a variety of physiologically active chemicals that benefit in the extension of life and the treatment of diseases. Plants' pharmacological activities are mediated by substances such as carbohydrates, proteins, enzymes, lipids, oils, terpenoids, flavonoids, sterols, and simple phenolic compounds (Prabakaran *et al.*, 2011). Also, Chang *et al.*, (2012) who recorded that *Saussurea lappa* (*costus roots*) can be utilized as an elective anti-oxidant operator in both the medical and food industries.

Therefore, the aim of this study was to evaluate the effect of aqueous extract of *Saussurea lappa* on productive performance and hematological profile in male weaning rabbits.

MATERIALS AND METHODS

Housing and management:

The current investigation began at a private rabbitry farm in Qalyubia province, Egypt's during winter season. Sixty male California rabbits, aged 6 weeks and weighing an average of 591.03 ± 11.9 g, were randomly divided into four equal treatments (15/each). Rabbits were housed in 60×55×40 cm wire galvanized batteries in a naturally ventilated container. Each cage has stainless steel nipples for drinking and feeders that allow each rabbit's feed intake to be measured individually. Temperatures indoor ranged from 22 to 25 °C, with relative humidity ranging from 45-58% and (16 h light and 8 h dark).

Water and feed were available *ad libitum*. All rabbits were kept in the same management instances. Their feed consumption (FC) was recorded weekly during the trial period, and they were healthy, hygienic and free of external parasites. The basal experimental ration was formulated and pelleted to cover the nutrient requirements of rabbits, feed was allowed to a standard pelleted diet according to NRC (1977), Table 1.

Table 1. Composition and chemical analysis of basal experimental diet

Ingredients	%
Yellow corn	6.22
Soybean meal, 44%	20.33
Wheat bran	23.33
Barley	17.00
Alfalfa hay	30.12
Ground limestone	1.00
Di-Calcium Phosphate	1.20
Common salt	0.50
Vit.+Min. premix*	0.30
Total	100.00
<i>Calculated analysis</i>	
Crude protein, %	17.02
Crude fiber, %	13.04
Ether extract, %	2.56
Digestible energy (kcal/kg diet)	2550

*Each 3 kg of premix contains: Vit. A=12,000,000 IU; D₃= 3,000,000 IU; E= 10.0 mg; K₃= 3.0 mg; B₁= 200 mg; B₂=5.0 mg B₆=3.0 mg; B₁₂=15.0 mg; Biotin=50.0 mg; Folic acid=1.0 mg; Nicotinic acid=35.0 mg; Pantothenic acid=10.0 mg; Mn=80 g; Cu=8.8 g; Zn=70 g; Fe=35 g; I=1 g; Co=0.15 g and Se=0.3 g.

Plant materials: Dry roots of *Saussurea lappa* (*costus roots*) were purchased from the local market of medicinal plant, Cairo, Egypt. Root specimens were grounded into a fine powder.

Aqueous Extract: About 10 g of dried powder costus roots (*Saussurea lappa*) were added to 100 ml of boiling distilled water and soaked for 2 hours, then, filtered and stored at 4°C. The final concentration of the aqueous extract was 10% according to Kaula *et al.*, (2018).

Doses: Supplementations of *Saussurea lappa* extract (*costus roots*) (**SLE**) were supplemented in drinking water 100, 200 and 400 mg/kg BW for 3 days weekly until 12 weeks of age, doses were done according to Abd El-Rahman *et al.*, 2020 and Abd Eldaim *et al.*, (2019).

***Saussurea lappa* analysis:** determination of total phenolic, total flavonoids and total antioxidant capacity was done by Elgharabawy *et al.*, (2021).

Experimental groups were distributing as follow:

Gp0: served as control,

Gp1: 100 mg SLE /kg BW,

Gp2: 200 mg SLE /kg BW and

Gp4: 400 mg SLE/ kg BW

Growing performance:

The body weight gain (AG) was calculated basis as follows:

AG = final live BW - initial live BW.

Feed consumption (FC) was deliberate as the difference between the weight of the feed offered and the weight of the remained at same day of weighing the animals. Feed conversion (FCR) ratio was computed as the ratio between feed consumption and weight gain per period.

Biochemical blood analysis:

At the end of the experiment, blood samples were drawn from the ear vein and centrifuged at 3000 rpm for 10 minutes at then plasma separated and stored at -20°C. Biochemical analyses of alanine aminotransferase (ALT); aspartate aminotransferase (AST) activity; total protein (TP); albumin (Alb) were determined while globulin (Glo) was calculated by the difference. Triglycerides (TG); total cholesterol (TC); high-density lipoprotein (HDL-c) were determined, while low-density lipoprotein (LDL-c) was calculated using the formula:

LDL-c, (mg/dl) = Total cholesterol - {HDL-c + (TG/5)}, which explained by Friedewald *et al.*, (1972).

Immune response and antioxidant status:

Different types of immune-globulins and antioxidant status in blood plasma (IgG, IgM, were determined. Total antioxidant capacity (TAC) and malonyldialdehyde (MDA) were determined using commercially available kits methods using spectrophotometers, (GNW-Model: SM-721).

Antibacterial assay:

On nutrient agar, the test was carried out using the well diffusion method. The examined bacteria were injected into tubes of trypticase soy broth and cultured there for 4 hours at 37 °C. These cultures' turbidity was adjusted using 0.5 McFarland. On the surface of solid nutrition agar plates, sterile cotton swabs were used to create a homogenous bacterial lawn. With a cork borer, a well with a diameter of was created (8 mm). SCE was injected into each well in varying amounts (100, 200, and 400 mg/kg BW). The plates were incubated for 24 hours at 37 °C. The diameter of the zone of inhibition (mm) was used to measure the extracts' antibacterial activity according to Sagar *et al.*, (2017) and Srinivasan *et al.*,(2016).

Statistical analysis:

Data was statistically analyzed by SPSS Program (SPSS, 2013), Version 20 software (SPSS, Chicago, IL, USA) on an IBM compatible computer. Mean, standard error, one-way analysis of variance (ANOVA). Duncan multiple range tests were used to test the differences among means (Duncan, 1955). The statistical model was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where: Y_{ij} = Any observation, μ = Overall mean, T_i = Effect of treatment, and e_{ij} = Experimental error.

RESULTS AND DISCUSSION***Effect of SLE on growth performance:***

Table 2 presents the effect of oral supplemented water intake with a gradual **SLE** on LBW, FC, BWG, and FCR. Estimation of the parameter production performance at the start and end of the experiment showed a significant increase ($P \leq 0.05$) in the combined final and gain weights of the *Saussurea lappa* treated groups in compared to the control and improved FCR too. Interestingly, **Gp4** recorded the highest final LBW and the best FCR. Currently, a growing global trend has been directed towards the use of natural products as prophylactic and growth-promoting food supplements. In the

Table 2. Effect of aqueous extract of costus roots on growth performance for weaning male rabbits at 12 weeks of age

Treatments	IBW, (g)	FBW, (g)	AG, (g)	FC, (g)	FCR
Gp0	593.1	2050.1 ^b	1457.0 ^b	5950.7 ^a	4.08 ^a
Gp1	590.8	2162.7 ^a	1571.9 ^a	5986.2 ^a	3.81 ^a
Gp2	588.1	2045.3 ^b	1457.2 ^b	5673.0 ^b	3.89 ^a
Gp4	592.1	2198.5 ^a	1606.4 ^a	5521.7 ^c	3.44 ^b
MSE	11.9	28.48	26.4	82.18	0.31
Sig.	NS	*	*	*	*

^{a,b} Means in the same column with different superscripts are significantly different ($P \leq 0.05$), MSE: mean of standard error. Gp0: control (un-supplemented), Gp1: supplemented with 100 mg SLE/kg BW, Gp2: supplemented with 200 mg SLE/kg BW, Gp4: supplemented with 400 mg SLE/kg BW; IBW: initial body weight; FBW: Final live body weight; AG: Average body weight gain; FC: feed consumption; FCR: feed conversion ratio.

current study, the oral administration of *Saussurea lappa* agreed with results obtained by Elizaa *et al.*, (2009) and Nehete *et al.*, (2010) who recorded oral intake of the aqueous extract of costus improving the body weight of mice. The same results obtained by Saad *et al.*, (2018) who reported that oral administration of an aqueous extract of Indian costus significantly increased body weights when compared to the control group, also, Kadhem (2019) showed a significant increase ($P \leq 0.05$) in final LBW and BWG of rabbits treated with the ethanolic extract of *Saussurea lappa* compared to the control group, through its contents which were flavonoids, proteins, and carbohydrates, which are necessary for growth, body repair, and maintenance.

Effect of SLE on biochemical blood parameters:

Current results showed that the levels of plasma total protein, albumin, globulin, AST, and ALT were nearly normal in rabbit's oral receiving water that had been gradually supplemented with an aqueous extract of costus roots. Also, all experimental groups' results for all parameter measurements were negligible (Table 3).

The causes of liver problems are the rising levels of the liver enzymes AST and ALT and the dropping levels of TP and albumin, it is possible that an overdose of any toxic substance caused the formation of reactive oxygen species and caused oxidative stress, which led to the hepatotoxicity. Because they are released into the blood stream following cellular damage, plasma AST and ALT are indicators in the diagnosis of hepatic injury (Valentine

Table 3. Effects of aqueous extract of costus roots on biochemical blood parameters for weaning male rabbits at 12 weeks of age

Treatment groups	TP, g/dl	Alb, g/dl	Glo, g/dl	AST, U/l	ALT, U/l
Gp0	6.90	4.13	2.77	25.30	29.10
Gp1	7.15	5.16	1.99	21.00	25.40
Gp2	7.21	5.02	2.19	22.20	23.32
Gp4	7.20	5.19	2.01	23.41	27.32
MSE	0.35	0.94	0.22	4.49	4.31
Sig. test	NS	NS	NS	NS	NS

^{a,b} Means in the same column with different superscripts are significantly different ($P \leq 0.05$), MSE: mean of standard error. Gp0: control (un-supplemented), Gp1: supplemented with 100 mg SLE/kg BW, Gp2: supplemented with 200 mg SLE/kg BW, Gp4: supplemented with 400 mg SLE/kg; TP: total protein, Alb: albumen; Glo: globulin; AST: aspartate aminotransferase; ALT: alanine aminotransferase activities.

et al., 1990). Hepato-toxins also hindered the liver's capacity to produce albumin Dubey *et al.*, (1994). Rabbits receiving any toxic substance had a reduction in total blood protein levels, which may be due to reduced protein synthesis caused by liver tissue injury (Kanchana and Sadiq 2011). The current study demonstrated negligible decrease levels of the liver enzymes AST and ALT as well as negligible rise level of TP, albumin and globulin in those supplemented with aqueous extract of costus roots when compared to the control group, indicating that exposure to phytochemical compounds such as flavonoids and chlorogenic acid, which act as antioxidant substances, serve to suppress free radical-induced lipid peroxidation and prevent any toxicity (Ravindran and Mohamed 2019). Also, Saad *et al.*, (2018) revealed that treatment of the hyper cholesterolemic mice with aqueous extract of Indian costus caused reduction in the activity of liver enzymes.

Effect of SLE on lipid profile and kidney function:

Table (4) indicates that the supplemented drinking water by different levels of LSE caused a significant reduction ($P \leq 0.05$) in plasma TC, TG and LDL-c while, elevated HDL-c. On the other hand urea and creatinine recorded insignificant levels.

The current study revealed significant reduction of lipid profile indices with rise levels of HDL in treatment groups than the control group. These parameters were significantly improved with Indian costus. In addition, the levels of TC, TG, and LDL-c were significantly lowered in the same groups.

Table 4. Effects of aqueous extract of costus roots on lipid profile and kidney functions for blood plasma of weaning male rabbits at 12 weeks of age

Treatment groups	TC mg/dl	TG, mg/dl	HDL-c, mg/dl	LDL-c, mg/dl	Urea, mg/dl	Crea, mg/dl
Gp0	145.80 ^a	110.80 ^a	58.60 ^b	65.04 ^a	25.45	0.71
Gp1	113.58 ^b	82.20 ^b	68.90 ^a	28.24 ^b	26.38	0.63
Gp2	120.46 ^b	79.98 ^b	72.81 ^a	30.96 ^b	28.43	0.64
Gp4	132.54 ^{ab}	84.69 ^b	69.21 ^a	46.39 ^{ab}	29.11	0.62
MSE	7.7	8.9	4.9	8.18	7.24	0.21
Sig. test	*	*	*	*	NS	NS

^{a,b} Means in the same column with different superscripts are significantly different ($P \leq 0.05$), MSE: mean of standard error. Gp0: control (un-supplemented), Gp1: supplemented with 100 mg SLE/kg BW, Gp2: supplemented with 200 mg SLE/kg BW, Gp4: supplemented with 400 mg SLE/kg; TC: total cholesterol; TG: triglycerides; HDL-c: high density lipoprotein; LDL-c: low density lipoprotein; Crea: creatinine.

These findings might suggest the protective effects of Indian costus against hyperlipidemia.

The decline in TC, TG, and levels of LDL-c in rabbits agree with results obtained by Bavarva and Narasimhacharya (2008) who revealed that rats treated with Indian costus significantly decreased the plasma levels of TC, TG, and LDL. The hypocholesterolemic effect of costus speciosus rhizomes might be due to the presence of phytochemicals, especially flavonoids and other phenolic compounds (Jha *et al.*, 2010), which have been reported as scavengers of free radicals. In terms of urea and creatinine, our results showed that using costus caused protects the kidneys from damage or elevates kidney enzymes. These findings are consistent with those obtained by Uboh *et al.*, (2014) who reported that costus leaves' juice on nitro cellular thinner nephrotoxicity in rats due to inhibition of lipid peroxidation and radical scavenging due to its phyto-constituents such as flavonoids, alkaloids, saponins, phenols, terpenoids, tannins, and cardiac glycosides and this might explain the ameliorated effect of Indian costus on renal pathology according to Hegazy *et al.*, (2020). On the other hand, the administration of an aqueous Indian costus extract decreased TG and TC levels. The release of LDL-c from plasma through increased LDL-receptor activity may be the explanation for the decrease in blood cholesterol after administration of the aqueous extract of Indian Costus (Lin *et al.*, 2004). According to Colca (2006), the increased HDL-c levels after the use of the ethanolic extract of costus speciosus may be attributable to an increase in the activity of the enzyme lecithin cholesterol acyltransferase, which may help to regulate blood lipid levels. Moreover, lipoprotein lipase (LPL) activity, which decreases triglyceride synthesis in the

liver, may be responsible for the decreased levels of triglycerides in the blood (Anderson 2003).

Effect of SLE on immunity and antioxidant status:

As shown in Table 5, *Saussurea lappa* extract oral administration in drinking water significantly boosts the immunoglobulin levels (IgG and IgM), TAC and decreasing MDA and SOD were evident in the *Saussurea lappa* administered rabbits relative to the control group. On the other hand, insignificant records regarding the CAT enzyme were noticed.

Through the control of cell receptors and lymphocyte expression, herbal medications can affect a wide range of functions, including the release of free radicals, histamine, phagocytosis, and the secretion of cytokines and immunoglobulins (Abd-Elhakim and Mohamed, 2016). *Saussurea lappa* can be utilized as antioxidant operator in the medical Chang *et al.*, (2012) via scavenging of nitric oxide (NO), 2,2-diphenyl-1-picrylhydrazyl, and radicals with lipid peroxidation inhibition.

In comparison to the control group, oral administration of *Saussurea lappa* ethanolic extract dramatically reduced the release of pro-inflammatory cytokines (ILet-12 and TNF-). Moreover, Tag *et al.*, (2016) recorded that the immunoglobulin levels (IgG and IgM) were significantly higher in the rats given oral *Saussurea lappa* than in the control group. The levels of immunoglobulin are significantly boosted by the *S. lappa* ethanolic extract. On the other hand, our results agree with Pandey *et al.*, (2005) who recorded that the extract had antioxidant activity with reduction of DPPH and a decrease in lipid peroxidation. It showed inhibition of superoxide radical (SOD) and inhibition of nitric oxide (NO) formation. Hamad and Kadhem, (2020) recorded that *Saussurea costus* roots acts as an antioxidant substance effect against toxicity.

At the same line Tripathi and Sharma, (1998) reported that *Saussurea costus* extract inhibited the oxidation of reduced glutathione and demonstrated the significance of thiols, especially cysteine and glutathione, for lymphocyte function. GSH is a non-enzymatic form of free radical defense. In line with this observation, glutathione was recorded by Govindarajan *et al.*, (2003) as a crucial component of intracellular defenses against oxidative stress. On the other hand, intracellular glutathione appears to be primarily in charge of defense against stomach cell damage brought on by ethanol.

Table 5. Effects of aqueous extract of costus roots on antioxidant status and immunity in blood plasma of weaning male rabbits at 12 weeks of age

Treatment groups	IgG, mg/dl	IgM mg/dl	TAC, μ mol/ml	SOD, IU /ml	CAT, IU /ml	MDA nmol/ml
Gp0	625 ^b	100 ^b	0.93 ^b	151.0 ^a	20.1	4.14 ^a
Gp1	700 ^a	140 ^a	1.81 ^a	147.9 ^a	17.1	2.56 ^b
Gp2	725 ^a	147 ^a	1.95 ^a	135.7 ^b	17.7	1.90 ^c
Gp4	695 ^a	137 ^a	1.84 ^a	122.3 ^c	18.9	2.34 ^b
MSE	13.7	5.3	0.36	6.1	6.08	0.69
Sig. test	*	*	*	*	NS	*

^{a,b} Means in the same column with different superscripts are significantly different ($P \leq 0.05$), MSE: mean of standard error. Gp0: control (un-supplemented), Gp1: supplemented with 100 mg SLE/kg BW, Gp2: supplemented with 200 mg SLE/kg BW, Gp4: supplemented with 400 mg SLE/kg, IgG: immunoglobulin G; IgM: immunoglobulin M; TAC: total antioxidant capacity, SOD: superoxide dismutase; CAT: catalase and MDA: malondialdehyde.

Effect of SLE on bacterial count:

The present examination showed that the antibacterial activity of aqueous extract of costus roots at the three concentrations tested against total bacterial count (TBC), Salmonella, E. coli, Proteus and Clostridium was more significant than that of the control group. Interestingly, the antibacterial activity is increased by increasing the concentration of *Saussurea costus*. However, the Gp4 recorded a low bacterial count of E. coli, Salmonella, Proteus, and Clostridia but a high count of TBC (Table 6).

Different levels (100, 200 and 400 mg) of *S. costus* were assayed for their antimicrobial activity against bacteria in caecum. The results indicated that the antibacterial activity is increased by increasing the dose of *S. costus* at a concentration of 400 mg/kg BW against all investigated bacteria, with inhibition on increased concentration for *Salmonella*, *E. coli*, *Proteus*, and *Clostridium*. Gram-positive bacteria are more sensitive to *S. costus* than Gram-negative bacteria. Among the examined bacterial strains, Salmonella and Clostridium were the most sensitive to inhibition; in the same respect, Proteus was found to have the most resistance to *S. costus*. These results are in agreement with those reported by Ariharan *et al.*, (2012) and Duraipandiyan *et al.*, (2012) who found that gram-positive bacteria tend to be more sensitive than gram-negative bacteria. Malabadi (2019) reported the antibacterial activity of different extracts of costus species against various strains of bacteria, including Salmonella, E. coli, Proteus, and Clostridium. In the same regard, Salim *et al.*, (2019) tested the antibacterial activity of hot and cold

Table 6. Effects of aqueous extract of costus roots on antimicrobial activity in caecum of weaning male rabbits at 12 weeks of age

Treatment groups	TBC, 10 ⁶ /cm ³	Salm., 10 ⁵ /cm ³	E. coli, 10 ⁵ /cm ³	Proteus, 10 ⁵ /cm ³	Clostridia, 10 ⁵ /cm ³
Gp0	3.34 ^a	0.91 ^a	2.82 ^a	1.28 ^a	1.95 ^a
Gp1	2.35b ^c	0.82 ^b	1.95 ^b	0.99 ^b	1.51 ^b
Gp2	2.47 ^c	0.73 ^c	1.75 ^b	0.58 ^c	1.48 ^b
Gp4	2.8 ^{ab}	0.63 ^d	1.85 ^b	0.54 ^c	1.16 ^b
MSE	0.08	0.21	0.34	0.09	0.09
Sig. test	**	**	**	**	**

^{a,b} Means in the same column with different superscripts are significantly different ($P \leq 0.05$), MSE: mean standard error. Gp0: control (un-supplemented), Gp1: supplemented with 100 mg SLE/kg BW, Gp2: supplemented with 200 mg SLE/kg BW, Gp4: supplemented with 400 mg SLE/kg; TBC: Total bacterial count; Salm.: salmonellae and E.coli: Escherichia coli.

ethanol extracts of *Costus speciosus* rhizome with different concentrations against Gram (+ve) and Gram (-ve) bacteria and revealed that Gram (+ve) bacteria were found to be more susceptible to all hot ethanol extracts with inhibition raising concentration. The antibacterial activity of different extracts of *Costus* was studied by Ariharan *et al.*, (2012) against Gram-positive (*Staph. aureus* and *S. epidermidis*) and Gram-negative (*E. coli*, *Salmonella typhimurium* and *Pseudomonas aeruginosa*).

Conclusively, oral administration of *Saussurea lappa* did not cause any adverse effects on growth performance, serum parameters and effective on bacterial count. Additionally, *Saussurea lappa* had the best profitability (Highest final body weight).

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تأثير مستخلص جذور القسط على الأداء الإنتاجي والاستجابات

الفيسيولوجية والعد البكتيري في الأرانب المفطومة

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أجريت هذه الدراسة في مزرعة أرانب خاصة بمحافظة القليوبية بمصر خلال فصل الشتاء بهدف معرفة تأثير نبات القسط الهندي على الأداء الإنتاجي وكفاءة الهضم ومكونات الدم للأرانب المفطومة. إستخدم في هذه الدراسة 60 أرنباً ذكراً من سلالة كاليفورنيا عمر 6 أسابيع بمتوسط وزن جسم حي 591.03 ± 11.9 جم. قسمت عشوائياً إلى أربع معاملات متساوية. أضيف لها مستخلص جذور القسط في ماء الشرب لمدة 3 أيام أسبوعياً حتى عمر 12 أسبوعاً). تم استخدام مجموعة Gp0 كمجموعة للمقارنة، في حين تم إعطاء مجموعات 100Gp1, Gp2, Gp4 و 200 و 400 ملجم من مستخلص جذور القسط الهندي/كجم من وزن الجسم على التوالي. أظهرت النتائج وجود زيادة معنوية على مستوى احتمال 5% في الوزن النهائي للجسم والزيادة المكتسبة في الوزن للمجموعات المعاملة بالقسط الهندي مقارنة بمجموعة الكنترول كما تحسنت (FCR) كفاءة التحويل الغذائي أيضاً. ومن المثير للاهتمام أن Gp4 سجلت أعلى وزن جسم نهائي وأفضل معدل تحويل غذائي. وكانت مستويات TP و Alb و Glo و AST و ALT في المعدلات الطبيعية. وقد أدى استخدام المستخلص المائي لجذور القسط إلى انخفاض معنوي على مستوى احتمال 5% في TG و HDL-C في الدم بينما أدى إلى ارتفاع HDL-C. من ناحية أخرى سجلت اليوريا والكرياتينين مستويات غير معنوية. عزز مستخلص جذور القسط بشكل كبير مستويات الجلوبيولين المناعي IgM و IgG، مقارنة بالمجموعة الضابطة. كان النشاط المضاد للبكتيريا للمستخلص المائي لجذور القسط عند التراكيز الثلاثة التي تم اختبارها ضد العدد الكلي للبكتيري (TBC)، السالمونيلا، البكتيريا القولونية أكثر معنوية من مجموعة المقارنة. ومن المثير للاهتمام أيضاً أن النشاط المضاد للبكتيريا يزداد بزيادة تركيز مستخلص جذور القسط الهندي، ومع ذلك سجل Gp4 عدداً منخفضاً من البكتيريا القولونية والسالمونيلا.

التوصية: يمكن الاستنتاج أن تناول مستخلص جذور القسط عن طريق الفم لم يسبب أي آثار ضارة على أداء النمو ومكونات الدم وله تأثير إيجابي على عدد البكتيريا. بالإضافة إلى ذلك كانت الأرانب المعاملة أفضل ربحية (الأعلى في وزن الجسم النهائي).