

Antibiotic Effect of Polyphenolic Compound Extracted from Tamarind (*Tamarindus indica* L.) Seed Coat on Productive Performance of Broilers

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ABSTRACT

An experiment was conducted to evaluate the effect of tamarind seed coat extract on the average daily weight gain, feed intake and feed conversion rate of broilers. Broilers were divided into 6 groups that received polyphenols from tamarind seed extract at 0 (control), 100, 200, 300, 400 and 500 mg/kg respectively in their diets for 21 days. The results revealed the following information: During the period of 36-42 days of age, the average daily weight gain of broilers that received tamarind seed coat extract at 100mg/kg in their diet was significantly higher than the weight gain of broilers that received tamarind seed coat extract at 0, 200, 400 and 500 mg/kg in their diets ($P < 0.05$). Throughout the experimental period, the average daily weight gain tended to be highest in the group that received tamarind seed coat

extract at 100 mg/kg in their diet. The feed intake and feed conversion rate of broilers in all groups were not significantly different ($P > 0.05$). This study demonstrated that tamarind seed coat extract has a property similar to antibiotic feed additives and provides slightly improved average daily weight gain.

INTRODUCTION

Antibiotic feed additives have been used for more than 50 years to enhance growth performance and prevent disease in livestock feeding environments. However, the current trend is to look for alternatives to antibiotic feed additives due to public concern about antibiotic residues in animal products and the potential evolution of antibiotic resistant bacteria. As a consequence, new commercial additives of plant origin, considered to be natural products acceptable to the consumer, have been proposed to livestock producers¹.

At present, the use of antibiotics for broilers has been limited in the European Union to only 4 antibiotics that are not associated with the treatment of humans. They are: avilamycin (AB) and flavophospholipol as growth promoter additives, and salinomycin sodium and monensin sodium as coccidiostats². Useful antimicrobial phytochemicals can be divided into several categories: phenolics and polyphenols, terpenoids and essential oils, alkaloids, lectins and polypeptides³.

The tamarind (*Tamarindus indica* L.) is a tree-type of plant belonging to the Leguminosae, caesalpinaceae family. It is indigenous to tropical Africa but has become naturalized in North and South America from Florida to Brazil, and is also cultivated in subtropical China, India, Pakistan, Indochina, Philippines, Java and Spain. Initially, the fruit shows a reddish-brown color that turns black or black brown, becoming more aromatic and sour on ripening. *T. indica* L. fruit pulp is used for seasoning, as a food component, and in juices⁴. Pumthong⁵ reported that tamarind seed coat is composed of polyphenols including tannins, anthocyanidin, and oligomeric anthocyanidins. Gu et al.⁶ found that the seed of tamarind contains^{29,32} procyanidin oligomers and 101.89 g/kg high molecular weight tannins, respectively. Moreover, Tsuda et al.⁷ reported that tamarind seed coat contains phenolic antioxidants, such as 2-hydroxy-30, 40-dihydroxyacetophenone, methyl 3,4-dihydroxybenzoate, 3,4-dihydroxyphenyl acetate and epicatechin. Extracts exhibit antioxidant potential by reducing lipid peroxidation *in vitro*⁸, and anti-microbial activity⁹.

Knowledge about using polyphenols in tamarind seed coat extract as a feed additive for broilers is limited. The objective of this study was to investigate the effect of polyphenols in tamarind seed coat extract on the productive performance of broilers. Results from this preliminary study would provide fundamental knowledge for using the polyphenols from natural products as feed additives in the poultry production industry.

MATERIALS AND METHODS

Chemicals: Fresh tamarind fruits were purchased from a local market in Maha Sarakham Province, in the northeastern part of Thailand. The pericarp and seeds were carefully separated from the fruit. The seeds were heated in a hot air oven at 140 OC for 45 min, then cooled and cracked to separate their outside brown layer. Only brown-red seed coats were collected and these were then ground into fine powder⁴. The polyphenols in the tamarind seed coat powder were extracted using 95% ethanol as a solvent (1:5, w:v). Tamarind seed coat powder and ethanol were mixed and pH adjusted to 4 by using 5% acetic acid. The mixture was shaken every 12 hours for 72 hours, and the upper solution was collected for further processing. Tannins in the extract of high molecular weight were precipitated using protein from non-fat milk. The protein was prepared by mixing fresh non-fat milk with 5% acetic acid (5:1, v/v). It was then held at room temperature overnight, and then the supernatant was discarded. The extracts with high molecular weight tannin and protein from non-fat milk were mixed, held at room temperature overnight, and the upper solution was collected. The pH of the extract was adjusted to 6 by using 3M of NaOH, rested at room temperature overnight, and the upper solution was collected. The polyphenols in the final solution were dried using a spray drying method. Total phenolic compounds in each gram of tamarind seed coat extract powder were analyzed by using the Folin-Ciocalteu method¹⁰.

Animal and experimental design: 180 1-day-old broilers (Ross) (*Gallus domesticus*) were obtained from a local commercial farm near the laboratory of the Faculty of Veterinary Medicine and Animal Science, Mahasarakham University. The experiments were performed from October to December, 2008 throughout which the chickens were fed a standard ration. A completely randomized design was used. When they were 28-49 days old, they were divided into 6 groups. Each group had 3 replications (10 broilers/

Table 1. Average dairy weight gain (ADG), feed intake (FI) and feed conversion rate (FCR) of broilers that received tamarind seed coat extract at 0, 100, 200, 300, 400 and 500 mg/kg in their diets.

Parameters	Day of age	0mg/kg	100mg/kg	200mg/kg	300mg/kg	400mg/kg	500mg/kg	SEM
ADG	28-35	57.05	63.96	62.43	60.86	58.00	60.52	3.57
(g/day)	36-42	78.10 ^a	90.48 ^a	78.09 ^b	84.76 ^{ab}	76.19 ^b	79.05 ^b	3.01
	43-49	91.43	91.43	90.48	84.76	78.10	80.95	5.40
	mean	75.52	81.95	76.99	76.80	70.76	73.50	3.01
FI	28-35	100.00	97.18	102.86	101.90	82.86	100.00	4.87
(g/day)	36-42	142.86	150.48	147.62	140.95	128.57	140.00	4.81
	43-49	163.81	169.52	163.81	171.71	151.43	160.29	8.51
	mean	135.56	139.05	136.83	138.19	120.95	133.43	5.21
FCR	28-35	1.75	1.51	1.67	1.68	1.43	1.66	0.08
	36-42	1.84	1.66	1.89	1.67	1.70	1.78	0.10
	43-49	1.80	1.86	1.60	1.96	1.94	2.02	0.13
	mean	1.80	1.68	1.73	1.77	1.69	1.82	0.06

^a and ^b within row, mean with no common superscript differ significantly ($P < 0.05$); SEM= standard error of the mean; ADG= average daily weight gain; FI=feed intake; FCR=feed conversion rate

replication) and received polyphenols from tamarind seed coat extract i.e., 0 (control group), 100, 200, 300, 400 and 500 mg/kg in diets (proximate composition of diet: CP = 21.4%, ME = 3,110 kcal/kg) ad libitum with continuous light and water supplies. The average daily weight gain and feed intake of broilers in each group were recorded and the feed conversion rate was calculated.

Statistical analysis: Data were analyzed with the ANOVA procedure. Means were separated by Duncan's multiple range tests. The level of significance was determined at $P < 0.05$.

RESULTS AND DISCUSSION

The average daily weight gain, feed intake, and feed conversion rate of broilers that received tamarind seed coat extract at 0, 100, 200, 300, 400 and 500 mg/kg in diets during the period of 28-49 days of age are presented in Table 1. During the period of 36-42 days of age, the average daily weight gain of broilers that received tamarind seed coat extract at 100mg/kg in their diet was significantly higher than the average daily weight gain of broilers that received tamarind seed coat extract 0, 200, 400 and 500 mg/kg in their diets ($P < 0.05$). During the entire experimental period, the average daily weight gain tended to be highest in the group of broilers that received tamarind seed coat extract at 100 mg/kg in their diet, though the difference in weight gain between the groups

was not significant ($P > 0.05$). Throughout the experimental period, the feed intake and feed conversion rate of broilers in all groups were not significantly different ($P > 0.05$).

Daniyan and Muhammad¹¹ studied the effect of crude aqueous and ethanol extract of *Tamarindus indicus* L. as antibacterial; they found that the ethanol extracts produce strong antibacterial activity against *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella paratyphi A*, and *Pseudomonas aeruginosa*, but *Staphylococcus aureus* was resistant to the extracts. Further, they hypothesized that alkaloids, flavonoids, saponin and tannin in the extract were the active ingredients of this plant. The properties of tamarind seed coat extract in this study show similar properties to antibiotic feed additives during the period of 28-49 days of age. The average daily weight gain of broilers that received tamarind seed coat extract at 100mg/kg in their diet was slightly higher than other groups.

Several studies have reported that tannin added to the feed of experimental animals leads to decreased growth and body weight gain¹². Moreover, the components of polyphenols from tamarind seed extract contain high molecular weight tannin¹³. After broilers received tamarind seed coat extract at 200, 300, 400 and 500 mg/kg in their diets, their productive performance did not differ from that of the control group; however,

the group that received tamarind seed coat extract at 100 mg/kg in their diets had an average daily weight gain that was higher than the control group. This study demonstrated that polyphenols from tamarind seed extracts prepared by precipitation with protein from non-fat milk and adjusted pH could reduce the effect of high molecular weight tannin to growth and body weight gain of broilers.

In conclusion, tamarind seed coat extract used in this study showed properties similar to antibiotic feed additives in that the extract slightly improved average daily weight gain of broilers, but did not affect the feed intake and feed conversion rate.

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REFERENCES

1. Cabuk M, Bozkurt M, Alcicek A, Akbas Y, Kucuklymaz K: Effect of a herbal essential oil mixture on growth and internal organ weight of broilers from young and old breeder flocks. *S Af J Anim Sci* 2006; 36: 135-141.
2. Hernandez F, Madrid J, Garcia V, Orengo J, Megaw MD: Influence of two plant extracts on broilers performance, digestibility, and digestive organ size. *Poult Sci* 2004; 83: 169-174.
3. Cowan MM: Plant products as antimicrobial agents. *Clin Microb Rev* 1999;12: 564-582.
4. Komutarin T, Azadi S, Butterworth L, Keil D, Chitsomboon B, Suttajit M, Meade BJ: Extract of the seed coat of *Tamarindus indica* inhibits nitric oxide production by murine macrophages in vitro and in vivo. *Food Chem Toxicol* 2004; 42: 649-658.
5. Pumthong G: Antioxidative activity of polyphenolic compounds extracted from seed coat of *Tamarindus indicus* Linn. Chiangmai Mai University, Thailand, 1999; IV-V.
6. Gu L, Kelm MA, Hammerstone JF, Zhang Ze, Beecher G, Holden J, Haytowitz D, Prior RL: Liquid chromatographic/ electrospray ionization mass spectrometric studies of procyanidins in foods. *J Mass Spectro* 2003; 38: 1272-1280.
7. Tsuda T, Watanabe M, Ohshima K, Yamamoto A, Kawakishi S, Osawa T: Antioxidative components isolated from the seed of tamarind (*Tamarindus indica* L.). *J Agri Food Chem* 1994; 42: 2671-2674.
8. Tsuda T, Osawa T, Makino Y, Kato H, Kawakishi S: Screening for antioxidant activity of edible pulses. *Biosci Biotechnol Biochem* 1993; 57: 1606-1608.
9. De M, Krishna De A, Baneerjee AB: Antimicrobial screening of some Indian spices. *Phytother Res* 1999; 13: 616-618.
10. Kahkonen MP, Hopia AI, Vuorela HJ, Rauha JP, Pihlaja K, Kujala TS, Heinonen M: Antioxidant activity of plant extract containing phenolic compounds. *J Agri Food Chem* 1999; 47: 3954-3962.
11. Daniyan SY, Muhammad HB: Evaluation of the antimicrobial activities and phytochemical properties of extracts of *Tamarindus indica* against some diseases causing bacteria. *Afr J Biotechnol* 2008; 7: 2451-2453.
12. Bennick A: Interaction of plant polyphenols with salivary proteins. *Crit Rev Oral Biol Med* 2002; 13: 184-196.
13. Sudjaroen Y, Haubner R, Wurtele G, Hull WE, Erben G, Spiegelhalder B, Changbumrung S, Bartsch H, Owen RW: Isolation and structure elucidation of phenolic antioxidants from tamarind (*Tamarindus indica* L.) seed and pericarp. *Food Chem Toxicol* 2005; 43: 1673-1682.