Effect of local medicinal herbs as feed additives on production performance and faecal parameters in laying hens

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Abstract

Medicinal herbs are gaining importance in both human and animal nutrition due to their bioactive components that possess a wide range of beneficial effects on body health enhancement. To concord with the banning of antibiotic growth promoters in animal nutrition, research was carried out to utilize phytogenic feed additives in poultry nutrition as the alternative to improve their overall performance. Therefore, the objective of this study was to evaluate the effects of dietary supplementation of the three selected herbs at the level of 1% on production performance and faecal parameters in laying hens. In this study, a total of 96 Bovans Brown layers of 32 wk old were subjected to four dietary treatments in the form of CRD, namely (T1) control, (T2) basal diet + 1% of turmeric rhizome powder, (T3) basal diet + 1% of Vietnamese coriander leaf powder, and (T4) basal diet + 1% of Dayak onion powder. The layers were given 7-d adaption period before the feeding trial started which lasted for 12 wk. The results showed that there was no significant difference ($P>0.05$) in the means of overall feed intake, egg mass, feed conversion efficiency as well as body weight gain among the treatment groups. The hen-day egg production and egg weight of birds in treatments T2 and T4 showed significant differences ($P<0.05$) compared to control group. Besides, the birds in the treatment groups supplemented with medicinal herbs (T2, T3 and T4) also showed significant reduction in faecal pH and faecal *Entero bacteriaceae* counts ($P<0.05$) compared to the control, while significantly improved ($p<0.05$) the faecal lactic acid bacteria counts as compared to those in the control group. Thus, the present study suggests that dietary supplementation of 1% of turmeric rhizome powder, Vietnamese coriander leaf powder and Dayak onion powder in layer diet can achieve better performance in terms of hen-day egg production and egg weight associated with favourable intestinal environment without any adverse effect.

Keywords: Laying hen, Turmeric, Vietnamese coriander, Dayak onion, Phytogenic feed additive.

Introduction

To ensure the efficiency and profitability of livestock production as well as sustain the food security due to the increasing demand of livestock produce, an enhancement in terms of nutrition together with other management is crucial for the maintenance of animal health and thus increasing production performance. In the layer poultry industry, the manipulation of feed compositions such as introducing phytogenic feed additives in layer diets have been studied to improve the egg production performance. Furthermore, studies also showed that phytogenics have the potential to be natural antibiotics, as the alternative to the antibiotic cum growth promoters which have been banned since

2006. Phytogenic feed additives are defined as plant based compounds that are mixed into animal diets at optimal level through amelioration of feed properties to improve animal production performance (Windisch *et al.*, 2008). Unlike the antibiotic growth promoter, these phytogenic feed additives are safe and do not produce any side effects, such as drug resistance (Padhi *et al.*, 2015). Aside from the benefits such as improving feed intake, phytogenics also help to stimulate the digestive activities in the gut. Findings showed that this might be due to the presence of bioactive components or plant secondary metabolites in the plants having many antimicrobial, antioxidant and immune-stimulatory properties (Liu *et al.*, 2014; Shahryar *et al.*, 2011).

Curcuma longa L., or turmeric, is a perennial herb that widely grown in tropical and subtropical regions (Rahardja *et al.*, 2015; Beevers *et al.*, 2011), in which it is commonly used as spice, food preservative and colouring agent as well as in the practices of Ayurverdic and traditional Chinese medicinal system since thousand years ago (Prasad *et al.*, 2011). Turmeric and its main active compounds – curcuminoids mainly curcumin are found to give the effects of antioxidant, antimicrobial and others, which enable it to be used in treating various illness such as gastrointestinal and respiratory disorders (Labban, 2014; Kafi *et al.*, 2017). In addition, it has been shown that curcumin in turmeric aids in improving the liver function which in turn increased the synthesis of vitellogenin and follicular development and thus increased the egg production performance (Saraswati *et al.*, 2013b).

Persicaria odorata L., or Vietnamese coriander, is an indigenous perennial herb from Southeast Asia (Gouri *et al.*, 2016). It is often used in local cuisine of Vietnam, Malaysia and Singapore as it has strong lemony scent (Sasongko *et al.*, 2011a) due to the (Z)-3-hexenal, (Z)-3-hexen-1-ol, decanal, undecanal, and dodecanal (Starkenmann *et al.*, 2006). Besides, it also has been used in traditional medicine to treat illnesses such as diarrhoea and inflammation. Researches revealed that these medicinal effects are related to the properties of Vietnamese coriander such as antibacterial and antifungal, antioxidant, antidiabetic and others (Ridzuan *et al.*, 2013; Shu *et al.*, 2009; Nanasombat *et al.*, 2009). According to Sasongko *et al.* (2011b), it consists of major volatile compounds such as long-chain aldehydes (eupatoriochromene, dodecanal and others) and plant secondary metabolites (flavonoids and phenolic compounds) (Gouri *et al.*, 2006). However, there is limited usage in animal nutrition.

Eleutherine palmifolia (L.) Merr, or Dayak onion is an indigenous herbaceous plant that originated from South America and widely found in the regions of Africa, Malaysia, Indonesia and Philippines (Agustin *et al.*, 2016). It is commonly used among Dayak tribe in Kalimantan as medicinal herbs to cure various illness such as high blood pressure, diabetes and cholesterol (Kuntorini *et al.*, 2010), as well as consumed by postpartum mothers as herbal drink for the healing process (Harlita *et al.*, 2018). It is reported that its bulb consists of several bio-active compounds such as naptoquinones (elecanacine, eleutherine, eleutherol, eleutherinone) and secondary metabolites that gives the properties of antioxidant and antimicrobial (Agustin *et al.*, 2016). In 2017, Maftuch revealed that its crude extract significantly reduced the bacterial population in fishes and reduce infection of fishes by inhibiting the growth of *A. hydrophila, V. harveyi and P. fluorescens* bacteria. However, information is lacking on the effect of inclusion in animal diet. Therefore, this study was performed to evaluate the effects of dietary supplementation of the three herbs on

production performance and faecal parameters in laying hens.

Materials and Methods

Preparation of treatment herbs, birds and experimental design

The present study was conducted at Faculty of Sustainable Agriculture, University of Malaysia Sabah in Sandakan Sabah. Fresh turmeric rhizomes, Vietnamese coriander leaves and Dayak onion bulbs were purchased from several local markets located at Sandakan, Sabah. The fresh herbs were chopped into pieces and oven dried at 55°C until a constant weight was achieved. The dried herb samples were then ground into powder form before being mixed with basal diet at the level of 1% (Table 1).

A total of 96 Bovans Brown layers with average age of 32 wk old were randomly allocated into four treatment groups, with six replicates per treatment and each replicate consisted of four birds, where each of the birds was kept individually in a cage. The dietary treatments consisted of (T1) control, (T2) basal diet + 1% of turmeric rhizome powder, (T3) basal diet + 1% of Vietnamese coriander leaf powder, and (T4) basal diet + 1% of Dayak onion bulb powder (Table 1). The birds were allowed 7 d of adaption period followed by the feeding trial which lasted for 12 wk. The experimental diets and clean drinking water were provided *ad-libitum* throughout the trial period.

Table 1. Ingredients and composition of experimental diets

Ingredients (%)	[1]T1	T2	T3	T4
Yellow corn	58.20	58.20	58.20	58.20
Soybean meal	24.10	24.10	24.10	24.10
Wheat	3.80	2.80	2.80	2.80
Crude palm oil	1.55	1.55	1.55	1.55
L-lysine	0.06	0.06	0.06	0.06
DL-methionine	0.16	0.16	0.16	0.16
MDCP	2.50	2.50	2.50	2.50
Limestone	8.00	8.00	8.00	8.00
Common salt	0.50	0.50	0.50	0.50
Vitamin premix	0.07	0.07	0.07	0.07
Mineral premix	0.06	0.06	0.06	0.06
Choline chloride	1.00	1.00	1.00	1.00
Treatment - herb	-	1.00	1.00	1.00
Total	100	100	100	100
Analysed composition (%)				
Dry matter	88.92	88.99	88.93	88.98
Ash	11.89	12.10	12.19	12.21
Crude protein	16.63	16.68	16.62	16.66
Ether extract	3.32	3.32	3.34	3.35
Crude fibre	3.18	3.38	3.43	3.20
Calcium	3.70	3.71	3.68	3.69

[1]T1 Control, T2 basal diet + turmeric rhizome powder, T3 basal diet + 1% of Vietnamese coriander leaf powder, and T4 basal diet + 1% of Dayak onion powder

Egg production

Eggs were collected daily and the weight of each egg as well as the egg mass were recorded. The hen-day egg production was calculated as the rate of production per hen per day. Feed intake was measured by subtracting the feed residue from total offered to the birds at weekly intervals whereas feed conversion efficiency was calculated as the ratio of feed intake per egg mass. For the parameter of body weight gain, it was calculated by subtracting the initial body weight from final body weight at the end of the trial. The mortality of the birds was also recorded throughout the feeding trial.

Faecal pH and faecal microbial count

The assessment of faecal pH and faecal microbial count was done at the end of the feeding trial. Fresh faecal samples from each treatment replicate were collected by using sterile plastic bags and stored in a chiller prior to laboratory analysis. For the measurement of faecal pH, one g of the faecal sample was mixed homogeneously with 9 ml of deionised distilled water in a sterile beaker. The pH was then recorded. For the faecal microbial count, the enumeration of lactic acid bacteria and *Enterobacteriacea* were performed on plate count agar by using MRS agar and EMB agar (Merck KGaA, Germany), respectively. The number of colony forming unit (CFU) was expressed as the base 10 logarithm of CFU (Log_{10} CFU) per g (Loh *et al.*, 2014).

Statistical analysis

Collected data were analysed by one-way analysis of variance (ANOVA) using the GLM procedure of Statistical Analysis System version 9.4. Significant differences among the treatment means were determined by Duncan's Multiple Range Test (DMRT) at $P<0.05$. The results of statistical analysis were presented as mean ± standard error of the mean (SEM).

Results and Discussion

Egg production performance

From Table 2 it can be seen that there was no significant difference ($P>0.05$) among the treatment groups in overall feed intake, egg mass, feed conversion efficiency and body weight gain. However, both T2 and T4 were significantly higher ($P<0.05$) in terms of overall hen-day egg production and egg weight as compared to T1 control group. Although T3 was numerically higher than T1 control group, it did not indicate any statistically difference ($P>0.05$).

Table 2. Effect of dietary turmeric, Vietnamese coriander or Dayak onion on laying hen performance

Parameter	Treatments[1]			
	T1	T2	T3	T4
Hen-day egg production (%)	87.95 ± 0.90[b]	91.57 ± 0.70[a]	89.39 ± 0.72[ab]	90.63 ± 0.79[a]
Feed intake (g/hen/day)	96.04 ± 0.49	97.19 ± 0.58	96.31 ± 0.56	97.64 ± 0.59
Egg weight (g)	57.95 ± 0.24[b]	59.12 ± 0.29[a]	58.64 ± 0.27[ab]	59.16 ± 0.29[a]
Egg mass (g/hen/day)	46.38 ± 0.32	47.19 ± 0.34	46.54 ± 0.36	47.36 ± 0.36
Feed conversion efficiency	2.07 ± 0.01	2.06 ± 0.01	2.07 ± 0.01	2.06 ± 0.01
Body weight gain (g)	170.08 ± 2.91	165.58 ± 1.77	162.38 ± 2.37	167.92 ± 2.86

[1]T1 Control, T2 basal diet + turmeric rhizome powder, T3 basal diet + 1% of Vietnamese coriander leaf powder, and T4 basal diet + 1% of Dayak onion powder

[a-b] Mean values with different letters in the same row are significantly different (P<0.05).

The result of present study demonstrated that the inclusion of 1% turmeric (T2) or Dayak onion (T4) in layer diet had significantly improved (P<0.05) the overall hen-day egg production and egg weight, however, 1% of Vietnamese coriander (T3) in layer diet just showed numerical improvement in the same parameters as compared with control group (T1). This result was in line with the findings of Kanagaraju *et al.* (2017), Abdel-Wareth *et al.* (2013), Park *et al.* (2012); however, Malekizadeh *et al.* (2012) reported that supplementation 1% of turmeric in layer diet had no significant effect on egg production and egg weight. Present result also showed contrast with Rahardja *et al.* (2015) in which the supplementation of turmeric up to 4% in the diet of old laying hens indicated significant difference in terms of egg production, but had no significant effect on egg weight. Hence, it could be deduced that 1% of Vietnamese coriander mixed in layer diet might not be adequate to result in significant impact of the parameters concerned.

This improvement might be related to the positive effects of bioactive compounds present in the medicinal herbs. Aside from enhancing digestion enzyme activities (Platel *et al.*, 2000), some researchers suggested that curcumin in the turmeric enhanced the functions of hepatocytes in liver and reproductive tracts by improving the synthesis of vitellogenin which then stimulated the deposition of egg yolk in the developing follicles, thus, resulting in increased egg production (Saraswati *et al.*, 2013a; Saraswati *et al.*, 2013b).

Beside active components, plant secondary metabolites such as flavonoids in the medicinal herbs were also known to exhibit the properties of antimicrobial and antioxidant which in turn improved the digestion and absorption of nutrients in the body (Liu *et al.*, 2014; Shahryar *et al.*, 2011) by increasing the number of beneficial

microbes and thus suppressed the colonization of pathogens in the intestinal environment.

On the other hand, the result of present study also indicated that there was no significant effect (P>0.05) on overall feed intake, egg mass, feed conversion efficiency and body weight gain, hence, suggesting that current level of dietary turmeric, Vietnamese coriander or Dayak onion in layer diet did not significantly affect feed palatability and feed intake. The result of overall feed intake in this study is in agreement with the findings by Radwan Nadia *et al.* (2008) and Park *et al.* (2012) as 0.5 or 1.0% turmeric in layer diet only increased numerically but was not statistically different compared to the basal diet. The slight increase in feed intake might be related to the palatability of the diet due to the addition of treatment herbs. Besides, curcumin in turmeric has been found to have similar effect with insulin that regulates the homeostasis of blood glucose in the body and thus controls feed intake (Seo *et al.*, 2008; Saraswati *et al.*, 2013b). Sherif (2016) described that increasing the turmeric level in layer diets resulted in significant reduction in egg mass, however Park *et al.* (2012) and Radwan *et al.* (2008) reported otherwise that it significantly enhanced the egg mass and feed conversion efficiency. Lastly, the result of body weight gain in this study corresponds with that of Sherif (2016) and Gowda *et al.* (2008), in which the inclusion of turmeric in layer diet did not significantly affect FCR, body weight gain and ADFI of laying hen and broiler chicken. However, Kafi *et al.* (2017) reported that the addition of dietary turmeric and ginger in broiler diet tended to increase both FCR and body weight gain.

Faecal pH and faecal bacterial count

There were significant improvements (P<0.05) in terms of faecal pH as well as faecal lactic acid bacteria and *Enterobacteriaceae* counts in the treatment groups supplemented with medicinal herbs as compared to T1 control group (Table 3). The lowest faecal pH and *Enterobacteriaceae* counts was observed in T4 followed by T3 and T2, while the highest faecal lactic acid bacteria count was also shown in T4 followed by T3 and T2.

Table 3. Effect of dietary turmeric, Vietnamese coriander or Dayak onion on faecal pH and faecal lactic acid bacteria and *Enterobacteriaceae* counts

Parameter	Treatments[1]			
	T1	T2	T3	T4
pH	7.00 ± 0.01^{a}	6.59 ± 0.02^{b}	6.55 ± 0.03^{b}	6.53 ± 0.04^{b}
LAB counts (log CFU/g)	6.78 ± 0.15^{b}	7.62 ± 0.13^{a}	7.68 ± 0.15^{a}	7.71 ± 0.20^{a}
ENT counts (log CFU/g)	6.98 ± 0.03^{a}	6.11 ± 0.04^{b}	6.07 ± 0.03^{b}	6.04 ± 0.04^{b}

[1]T1 Control, T2 basal diet + turmeric rhizome powder, T3 basal diet + 1% of Vietnamese coriander leaf powder, and T4 basal diet + 1% of Dayak onion powder

[a-b] Mean values with different letters in the same row are significantly different (P<0.05).

The significant reduction of faecal pH in all the treatment groups supplemented with medicinal herbs (T2, T3 and T4) might be associated with the significant improvements in log colony-forming units of bacterial counts in faeces. This result is in agreement with antibacterial properties of turmeric, Vietnamese coriander and Dayak onion due to the presence of active compounds as described by Labban *et al.* (2014), Ridzuan *et al.* (2013) and Harlita *et al.* (2018). These active compounds were reported to have selective inhibition between beneficial intestine microflora (lactic acid bacteria) and

pathogenic bacteria (*Enterobacteriaceae*) and at the same time promoted the growth and activity of beneficial bacteria in the gut, and thus improved animal health (Cardelle *et al.*, 2010; Sharma *et al.*, 2006). Furthermore, previous research also reported similar finding in which significant reduction in faecal total bacterial count and faecal coliform count were observed in the layers fed with herbal mixture supplement (tulsi, garlic, turmeric, fenugreek and ginger) (Priya *et al.*, 2017).

Conclusion

In conclusion, the present study suggests that addition of medicinal herbs such as turmeric, Vietnamese coriander and Dayak onion at the level of 1% in layer diet can improve hen-day egg production and egg weight, associated with favourable intestinal environment without any adverse effect to the laying hens.

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