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Effect of Combination of Noni (*Morinda citrifolia* L.) Juice and Palm Sugar (*Arenga pinnata*) Supplementation in Drinking Water on Lipid Profile of Broiler Chicken

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Abstract: A study was carried out at the Poultry Department, Faculty of Animal Husbandry, Padjadjaran University, Bandung Indonesia, in order to determine the effect of Noni (*Morinda citrifolia* L.) juice and Palm sugar (*Arenga pinnata*) supplementation in drinking water on the lipid profile of broiler chicken. One hundred (100) day old commercial broiler chicks were randomly allocated to four (4) treatment groups as T1, T2, T3 and T4 with 25 birds per treatment group replicated five times of five (5) birds per replicate in a Complete Randomized Design (CRD). The birds in the first group (T1) were given only 0.3% Noni in drinking water, while as other groups were supplemented with 0.3% Noni+2% Palm sugar (T2), 0.3% Noni+3% Palm sugar (T3) and 0.3% Noni+4% Palm sugar (T4). The blood samples were randomly collected from three (3) birds per replicate at the end of the study at 5th week and analyzed for the estimation of blood lipid profile viz. Total Cholesterol, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL) and Triglycerides. Results revealed that using combination of Noni and Palm sugar significantly ($p < 0.05$) decreased the total Cholesterol, triglyceride and Low Density Lipoprotein (LDL) levels. A numerical decrease in the levels of total cholesterol and LDL was observed with increase in the level of Palm sugar among the treatment groups. Highest reductions were observed in the groups supplemented with 0.3% Noni+4% Palm sugar (T4). Although, High Density Lipoprotein (HDL) did not increase in the present study but the ratio between HDL and LDL increased numerically in the treatment groups with increase in the concentration of Palm sugar. Thus, in view of the results obtained, it could be concluded that both Noni and Palm sugar have beneficial health effects with regard to their ability in altering the lipid profile of broiler chicken.

Key words: Broiler chicken, lipid profile, noni, palm sugar

INTRODUCTION

The awareness about the importance of nutritious food has contributed to an increase in Indonesian people's consumption of chicken meat (Ditjennak, 2009). Several factors such as lifestyle, a diet rich in cholesterol, age and hypertension, have been reported to cause heart failure (Schaefer *et al.*, 1995). Further, the high levels of cholesterol, particularly low-density lipoprotein (LDL), are mainly responsible for hypercholesterolemia (Krieger, 1998), which is a risk factor for cardiovascular diseases such as atherosclerosis and myocardial infarction (Wald and Law, 1995; Krieger, 1998). Low levels of triglyceride and LDL levels are desirable health outcomes known to have resulted from the use of some plant materials (Ojiako and Nwanjo, 2009).

Noni (*Morinda citrifolia* L.) is a native plant of Indonesia, well known for having good health beneficial effects. It contains glucoside, acetic acid, benzoic acid, glucose, heptanoic acid, linoleic acid, polysaccharides, potassium, scopoletin, selenium, sodium, serotonin, calcium, L-arginine, iron and alanine (Kustiyah, 2003). Noni also contains vitamin A, C, B and a variety of active components such as terpenoid, damnacanthal,

xeronine, proxeronine, anthraquinone, coumarin and scopoletin which are important to improve the cell function of the body (Winarti, 2005). Noni has been considered very important to control many diseases, particularly atherosclerosis and dyslipidemia (Schnorh, 1994). It also functions as an endothelial vasodilator and inhibits HMG Co-A (3-hydroxy-3-methyl-glutaryl Co-A) activity, thereby inhibiting lipoprotein lipase which is responsible for hydrolysis of plasma lipids (Boger *et al.*, 1997). Noni is one of the traditional medical plants which contain active antioxidant ingredients like Selenium which has an important function to activate glutathione peroxidase and neutralize free radicals which attack fat molecules in the body (Purbaya, 2002; Kusnandar and Rahmawati, 2003). Noni juice has been reported to inhibit free radicals and having antioxidant activity more powerful than vitamin C, pigoenol and grape seed (Winarti, 2005). Molecular modifications in various tissues results in an imbalance between protective antioxidants (antioxidant defenses) and increased production of free radicals. This is the initial oxidative damage known as oxidative stress and Noni has been reported to reduce this oxidative damage

(Setiawan and Suhartono, 2005). Sally (2003) has reported that Noni has the ability to reduce blood cholesterol, triglyceride and LDL in mice but scanty reports in this regard are available.

Palm tree, often found in Indonesia, grows at an altitude from 20 up to 1400 meters above sea level and has trunk diameter of approximately 65 cm (Safari, 1995). Palm sugar (*Arenga pinnata*) contains disaccharide carbohydrates, composed of two monosaccharides viz. glucose and fructose monomers which are joined by ties of alpha 1, 2. Micronutrients in palm sugar, among others, are mineral salts, thiamine (vitamin B1), riboflavin (vitamin B2), nicotinic acid (vitamin B3), pyridoxine (vitamin B6), cyanocobalamine (vitamin B12) and ascorbic acid (vitamin C) (Nangoy *et al.*, 2013). Palm sugar is believed to have the properties of reducing the blood cholesterol, triglyceride and LDL levels, however little work in this regard has been reported.

Keeping in view the aforementioned properties, Noni juice and Palm sugar were utilized in this study via drinking water to determine their effect on the lipid profile of broiler chicken.

MATERIALS AND METHODS

Environment of the study: The research was conducted in Poultry Department, Faculty of Animal Husbandry, Padjadjaran University, Bandung Indonesia. Noni (*Morinda citrifolia* L.) fruit was purchased from the local market in Bandung West Java, Indonesia, washed and blended with water in the ratio of 1: 2 (w/v) ratio. The resultant mixture was then filtered with filter cloth to prepare the juice (Adriani *et al.*, 2014). Likewise, Palm sugar was also processed and utilized via drinking water.

Experimental design: A total of one hundred day old commercial broiler chicks were used in this study in a Complete Randomized Design (CRD), randomly assigned into four treatment groups of T1, T2, T3 and T4 with twenty five birds per treatment group replicated five times of five birds per replicate. The birds in the first group (T1) were given only 0.3% Noni in drinking water, while as other groups were supplemented with 0.3% Noni+2% Palm sugar (T1), 0.3% Noni+3% Palm sugar (T2) and 0.3% Noni+4% Palm sugar (T4). The test diets and potable water were supplied at *ad libitum* throughout the experimental period of five weeks and all the vaccinations and other conventional management practices were strictly adhered to.

Collection of blood samples: Blood samples were collected at the end of 5th week which was the termination period of the experiment and five birds were randomly picked from each treatment group. Five millilitre of blood from each bird was collected using

needle and syringe into a labeled sterilized bottle containing ethylenediamine tetra-acetic acid (EDTA) and samples were used for estimation of lipid profile. Total Cholesterol was analyzed by CHOD-PAP (Cholesterol Oxidase Phenylperoxidase Amino Phenozonephenol) method (Richmond, 1973). Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) were estimated by enzymatic method (Kaniawati, 2000). Triglycerides were analyzed by GPO (Glycerol-3-Phosphate Oxydase) method (McGowand, 1983).

Statistical analysis: Data Collected were subjected to analysis of Variance (ANOVA) of Steel and Torrie (1980) and were means difference exists, they were separated using multiple range test by using Duncan (1995) with 5% significant level.

RESULTS AND DISCUSSION

The data of various lipid profile parameters have been presented in Table 1. Lipid profile serve as diagnostic indices in conditions such as chronic obstructive jaundice, hepatitis, coronary heart disease and atherosclerosis (Owen *et al.*, 2011). Hyperlipidaemia is one of the risk factors for coronary heart disease while cholesterol is the major lipid constituent of atherosclerotic plaque (Ekpo *et al.*, 2007). The results revealed that Total cholesterol decreased significantly ($p < 0.05$) in the groups supplemented with Noni and Palm sugar in the drinking water. A proportional decreasing trend was found with increase in the level of Palm sugar in the drinking water, with highest reduction of 91.00 ± 2.83 mg/dl in the group supplemented with 4% Palm sugar (T4) compared to 106.5 ± 0.71 mg/dl in the group fed only 2% Palm sugar (T2) along with 0.3% Noni in both. The level of triglyceride also decreased in the groups fed combination of Palm sugar and Noni (T2, T3 and T4) compared to the group supplemented with Noni alone. Anonymous (2015) also reported that Palm sugar helps to reduce the levels of blood cholesterol and triglyceride, however it is not clear as to how it helps in their reduction; therefore, further studies in this regard are demanded. Further, Sally (2003) reported reduction in the total cholesterol and triglyceride in mice as a result of Noni infusion. The Noni and Palm sugar may have reduced the biosynthesis of triglyceride and favoured the redistribution of cholesterol among the lipoprotein molecules. Moreover, the Coumarin present in the Noni has been attributed to increase the secretion of bile and Nitric Oxide, thus triggering the excretion of cholesterol through the faeces and its subsequent decrease in the blood (Maslachah, 2005). Further, Zainuddin (2005) and Nuraini *et al.* (2008) reported that the presence of beta-carotene in noni decreases the cholesterol level in the blood as it inhibits the action of HMG-CoA reductase enzyme that plays a role in the formation of mevalonate in cholesterol biosynthesis.

Table 1: Effect of noni and palm sugar on lipid profile of broiler chicken

Parameter	T1	T2	T3	T4
Total Cholesterol (mg/dl)	114.0±15.38 ^a	106.5±0.71 ^a	104.5±14.85 ^a	91.00±2.83 ^b
Triglyceride (mg/dl)	22.33±7.51 ^a	12.08±2.85 ^b	19.00±1.41 ^a	12.00±2.83 ^b
HDL (mg/dl)	90.67±12.01	88.50±0.71	86.50±14.85	89.60±1.41
LDL (mg/dl)	18.90±5.99 ^a	15.60±0.57 ^a	14.20±0.28 ^a	11.60±0.85 ^b

Means within the same row with different superscripts are significantly different ($p < 0.05$)

Suppression of mevalonate inhibits the formation of squalene and lanosterol, both of which are involved in the biosynthesis of cholesterol through a series of reactions. In the present study, the supplementation of Noni and Palm sugar lowered the cholesterol and triglyceride levels of broiler chickens indicating that their use would not contribute to any disease associated with hyperlipidaemia.

Although, the HDL levels didn't differ significantly among the treatment groups, however, the ratio of HDL to LDL increased numerically among the treatment groups with increase in the level of Palm sugar. HDL exerts part of its anti-atherogenic effect by counteracting LDL oxidation and recent studies also showed that HDL promotes the reverse cholesterol transport pathway, by inducing an efflux of excess accumulated cellular cholesterol and prevents the generation of an oxidatively modified LDL (Yokozawa *et al.*, 2006). Further, in the present study, the level of LDL decreased significantly ($p < 0.05$) and varied numerically with increase in the level of Palm sugar with constant level of Noni. Highest reduction of 11.60±0.85 mg/dl was observed in the group fed 4% Palm sugar along with 0.3% Noni (T4) as compared to 15.60±0.57 mg/dl in the group fed 0.3% Noni and only 2% Palm sugar (T2). Sally (2003) also observed reduction in the level of LDL after Noni infusion in case of mice. Excess LDL gets deposited in the blood vessel walls and becomes a major component of atherosclerotic plaque lesions (Adaramoye *et al.*, 2008). LDL is target of cardiovascular disease risk-reduction therapy (Kwiterorich, 1997). Thus, it could be concluded that both Noni and Palm sugar have beneficial health effects as could be observed by their effect on reducing the levels of blood total cholesterol, triglyceride and LDL because of their biochemical constituents. However, the mechanism of action by which Palm sugar helps in reduction of these vital parameters is unclear, therefore, further studies in this regard are warranted.

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