Lipid Deterioration of Layer Diet That Contains Lemuru Fish Oil (*Sardinella longiceps*) and Turmeric (*Curcuma domestica*) as Antioxidant During Storage Period

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Abstract

A research aimed to to evaluate lipid deterioration of layer diet which contains lemuru fish oil (Sardinella longiceps) and turmeric (Curcuma domestica) as antioxidants during storage period. The experimental design used was completely randomized design with 5 x 4 factorial and 2 repetitions. The factors were diet (P) ; P0 : 3% LFO (Sardinella longiceps) in diet, P1 : 3% LFO (Sardinella longiceps) + 0,3% turmeric (Curcuma domestica) in diet, P2 : 3% LFO(Sardinella longiceps) + 0,6% turmeric (Curcuma domestica) in diet, P3 : 3% LFO(Sardinella longiceps) + 0,9% turmeric (Curcuma domestica) in diet, P4 : Used of ration 3% LFO (Sardinella longiceps) + 0,02% BHT. Another factor is storage period (Q) ; Q0 : 0 weeks, Q1 : 2 weeks, Q2 : 4 weeks, Q3 : 6 weeks. The measured were moisture content, extract ether content, free fatty acid and peroxide numbers. The use of antioxidant had significant effect (P<0,01) to decrease free fatty acid, peroxide number and extract ether content. Moreover, storage period had significant effects (P<0,01) in increasing moisture content, free fatty acid, formation peroxide numbers; in contrast, it decreased extract ether content. It is worth noting that the diet at the fourth week of storage could still be used. Similarly, the use of different levels of antioxidant and different storage period had significant effects (P<0,01) on moisture content, free fatty acid and formation of peroxide number. In conclusion that the use of use of 0,9% ; P3 : (3% LFO(Sardinella longiceps)+0,9% turmeric (Curcuma domestica) in diet, turmeric and BHT were able to decrease free fatty acid, and peroxide number formation.

Keywords: antioxidant, free fatty acid, peroxide number and moisture content, storage period

Introduction

Poultry productivity is mostly affected by quantity and quality of diet; which contains highly nutritious components. Therefore, it is crucial to maintain diet qual-

ity in certain storage period as rancidity and nutritive value decrease may occur. Fish oil supplementation is commonly used to fulfil energy requirement in poultry (Saerang, 2003; Fenita *et al* 2005 ; Santoso *et al*, 2010.). Lemuru fish oil *(Sardinella longiceps*) is one of feed supplement, which is a waste product of Lemuru fish oil processing industry. Lemuru fish oil is rich of unsaturated fatty acid and omega-3 (25.17%). Research has been proven that feeding lemuru fish oil is economical as diet supplement (Fenita 2002; Sudibya 1998; Sastrodiharjo *et al* 1998; Fenita *et al* 2005; Fenita *et al* 2010) and stated that Lemuru fish oil supplementation up to 3% significantly increase egg production and has a better feed conversion ratio. A negative effect of Lemuru fish oil supplementation in diet is a short storage period as it may experience deterioration. Diet deterioration such as rancidity and decreasing nutritive value are due to prooxidant which proceeds oxidation process; therefore, a rancidity inhibitor is require to minimize nutrition deterioration (Winarno, 2004) and Fenita *et al* (2005; 2010). There are two types of antioxidants; synthetic and natural antioxidant. Butylated Hydroxytoluena is an effective synthetic antioxidant; however its toxicity contributes negative side effects. In contrast, turmeric (*Curcuma domestica*) is an alternative natural antioxidant that contains antimicrobial agents. Turmeric, a herbal plant, is widely used in Indoesian society as food preservative. According to Suwandi dan Hidayat (1995) antioxidant activity of turmeric is much greater than other herbal plants (curcumin, desmetoxy curcumin, dan bisdesmetoxy curcumin). Sengngeng (1996) mentioned that the use of turmeric of 0,6% as antioxidant as well as natural anti-toxin in broiler chicken as it significantly maintain peroxide number, decreases crude fat and crude aflatoxin. Aim of this research was to evaluate lipid deterioration of layer diet diet which contains lemuru fish oil (S*ardinella longiceps*) and turmeric (C*urcuma domestica)* as antioxidant during storage period.

Materials and Methods

The experiment design used was completely randomized design with 5 x 4 factorial and 2 repetitions. The factors were diet (P); P0: 3% LFO (S*ardinella longiceps*) in diet, P1: 3% LFO(S*ardinella longiceps*) + 0.3% turmeric (C*urcuma domestica)* in diet, P2: 3% LFO(S*ardinella longiceps*) + 0.6% turmeric (C*urcuma domestica)* in diet, P3: 3% LFO(S*ardinella longiceps*) + 0.9% turmeric (C*urcuma domestica)*in diet, P4: Used of ration 3% LFO (S*ardinella longiceps*) + 0.02% BHT. Another factor is storage period (Q); Q0: 0 weeks, Q1: 2 weeks, Q2: 4 weeks, Q3: 6 weeks. The data were analyzed by using analysis of variance (ANOVA), any significant results would be tested by using Duncan Multiple Range Test (Stell and Torrie, 1999). The variables observed were moisture content, extract ether content, free fatty acid and peroxide numbers. Lemuru fish oil is supplied by PT. Bali Mayu Desa Nagara/Nagari. Bali. Feed formulation . The formulation is referred to Rasyaf (1994) and Fenita (2010) with ± 17% crude protein and ± 2750kcal/kg of diet.

Results and Discussion

Results showed that diet which contains lemuru fish oil (S*ardinella longiceps*) and turmeric (C*urcuma domestica)* as antioxidant during storage period had a significant effect on moisture content (P<0,01). In general, a higher amount of turmeric meal resulted in higher moisture content. The higher moisture content may due to moisture content of the turmeric meal. Sumardi (1992) revealed that of 100 grams diet intake, 11.40 grams is moisture content that is contributed by turmeric meal. A DMRT test found a significant result of moisture content (P<0.01). The highest moisture content was at the 6th week of storage (Q3 11.09%); however, the lowest moisture content was at 0 week (Q0 10.37%). Fenita *et al* (2005) stated that the moisture content is probably influenced by storage room temperature and humidity. Furthermore, Syamsu (2003) mentioned that storage period affects moisture content of diet. Antioxidant level and storage period had significant interraction with moisture content (P<0.01). BHT treatment (P4) and six weeks storage period showed the highest moisture content 11.26%; however, the lowest moisture content was at the storage of 0 week and 10% BHT treatment.

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Crude fat content, There was insignificant different between P3 and P0; however, P0 was significantly different from P1, P2 dan P4. Generally, a higher turmeric level resulted in a higher decrease fat content of diet. Lemuru fish oil supplementation in P1, P2, P3 is able to minimize the fat content decrease. According to Sejati (2002) a lower concentration of oxidizeable materials is able to inhibit oxidation; in contrast, at a higher concentration antioxidant materials can be prooxidative. Storage period highly significantly decreased crude fat content (P<0.01). The decrease in crude fat content is also determined by storage period; the longer storage period the more deterioration diet occurs. Ketaren (1986) mentioned that fat rancidity is caused by

Table 1. Average moisture content (%), crude fat content (%), free fatty acid and peroxide number acid

Storage period (Week)	Level of antioxidant					Average	F
	P0	P1	P2	P3	P4		
				Moisture content (%)			
0 (Q0)	10.21^{ab}	10.33 ^{bcd}	10.48^{cd}	10.71^{f}	10.10^{a}	10.37^{A}	
2 (Q1)	10.33 ^{bcd}	10.51^{dc}	10.51^{dc}	10.83^{fgh}	10.29^{bc}	10.49^{B}	
4 (Q2)	10.70^{f}	10.85^{fgh}	10.67^{cf}	11.01^{hi}	10.78^{fg}	10.80^{C}	
6 (Q3)	10.97^{hi}	11.15^{ij}	10.96^{ghi}	11.12^{ij}	11.26^{i}	11.09^{D}	
Average	10.55^{A}	10.71^{B}	10.65^{AB}	10.92^{C}	10.61^{AB}		
Interaction							**
				Crude Fat Content (%)			
0 (Q0)	5.28	5.27	5.24	5.04	5.27	5.22^{c}	
2 (Q1)	5.13	5.21	5.22	4.96	5.16	5.14^{bc}	
4 (Q2)	5.00	5.14	5.18	4.90	5.05	5.05^{b}	
6 (Q3)	4.44	4.45	5.01	4.39	4.73	4.60^{a}	
Average	4.96^{ab}	5.02^{bc}	5.16^{c}	4.82^{a}	5.05^{bc}		
Interraction							ns
				Free fatty acid			
32.99^{a}	32.38^{a}	32.44^{a}	31.86^{a}	32.24^{a}	32.38^{A}		
41.94^{c}	39.00^{b}	34.58^{a}	33.47^{a}	33.47^{a}	36.49^{B}		
51.51^{fg}	49.17^{ef}	46.62^{dc}	45.97^{a}	48.66^{c}	48.39^{C}		
62.22^{j}	56.44^{i}	53.05^{gh}	52.98^{gh}	54.75^{hf}	55.89^{D}		
47.17^{C}	44.25^{B}	41.67^{A}	41.07^{A}	42.28^{A}			
Average							**
				Peroxide number (mg O/100 g sampel)			
0 (Q0)	2.15^{a}	2.10^{a}	2.06^{a}	2.03^{a}	2.02^{a}	2.07^{A}	
2 (Q1)	2.66^{b}	2.71^{b}	2.61^{b}	2.51^{b}	2.55^{b}	2.61^{B}	
4 (Q2)	3.85^{e}	3.81^{de}	3.62^{d}	3.66^{de}	3.14^{c}	3.62^{C}	
6 (Q3)	4.30^{g}	4.17^{fg}	4.18^{fg}	4.08^{f}	4.19^{fg}	4.18^{D}	
Average	3.24^{C}	3.20^{BC}	3.12^{BC}	3.07^{AB}	2.98^{A}		
Interaction							**

P0: 3% LFO (S*ardinella longiceps*) in diet, P1: 3% LFO(S*ardinella longiceps*) + 0,3% turmeric (C*urcuma domestica)* in diet, P2: 3% LFO(S*ardinella longiceps*) + 0,6% turmeric (C*urcuma domestica)* in diet, P3: Used of ration 3% LFO(S*ardinella longiceps*) + 0,9% turmeric (C*urcuma domestica)*, P4: Used of ration 3% LFO (S*ardinella longiceps*) + 0.02% BHT. Another factor is storage period (Q); Q0: 0 weeks, Q1: 2 weeks, Q2: 4 weeks, Q3: 6 weeks. Bars with different letters indicate the group mean is significantly different ($P<0.01$).

several factors: (1) Odor absorption by fat (2) Enzymatic action in fat content tissue materials (3) Microbial action (4) Oxygen oxidation. Furthermore, Winarno (2004)

stated that fat deterioration might be caused by tainting, hydrolization and oxygen. It is found that there is no correleation between antioxidant level and storage period ($P>0.05$).

Free fatty acid, utilization of turmeric *(Curcuma domestica)* antioxidant and BHT significantly decreased ($P<0.01$) free fatty acid; however, storage period very significantly increased free fatty acid ($P<0.01$). Effects of antioxidant utilization and storage period on free fatty acid during the experiment are shown on table 2. Utilization of turmeric antioxidant showed that free fatty acid of P3 treatment group was highly significant ($P<0.01$) compared to P0 and P1. Length of storage mearurement on different storage periods showed that at the storage period of 0 week had the lowest free fatty acid content (32.38%); in contrast, the highest free fatty acid content was at the measurement of week 6th (55,89%). Ketaren mentioned that free fatty acid is formed as fat hydrolisa and oxidation process. Moisture content of diet was increasing as time storage was prolonged (Table 5) which stimulated fat hydrolization of diet so that the free fatty acid would be increasing. A rapid increase of free fatty acid indicates fat deterioration and a decrease in fat content of stored diet.

The storage up to 4 weeks had free fatty acid of 48.39%; however, at the 6 weeks of storage, the free fatty acid of 55.89%. A higher percentage of free fatty acid in diet is an indication that the diet cannot be given to animals as mentioned by Anggorodi (1985) that diet cannot be given to the animals if the free fatty acid content is more than 50%. There was a significant interaction between antioxidant and storage period ($P<0.01$) on free fatty acid. The lowest free fatty acid was on P3 (0 week storage); whereas, the highest free fatty acid was on P6. In general, antibiotic utilization on diet and length of storage are contributing factors to increase free fatty acid content on diet.

Peroxide number

Results showed that turmeric *(Curcuma domestica)* and BHT (P treatment groups) and storage period (Q treatment groups) were highly significantly affect peroxide number ($P<0.01$) as shown at Table 2. Different level of antioxidant used had a very significant effect on peroxide number ($P<0.01$). A rapid increase of fat deterioration was due to an increase in storage period which resulted in an increase in peroxide number. Peroxide formation was stimulated by the present of oxygen and light.which accelerates oxidation process and increases peroxide number; which are followed by hydroperoxide formation as fat. After that, fatty acid is broken down in form of aldehyde, keton and free fatty acid (Ketaren, 1986 ; Fenita, 2010). There are a very significant correlation ($P<0.01$) between oxidant level on diet and storage period on peroxide formation. The lowest peroxide number was at P4 at 0 week of storage period (2,02 mg O/100 g sample). However, the highest peroxide formation was at P0 and 6 weeks storage period (4,30 mg O/100 g sample). In general, antioxidant on diet and storage period significantly affects peroxide formation. The

less turmeric (Curcuma domestica) on diet with a longer storage period would result in an increase in peroxide number.

Conclusion

In conclusion, 0.9% turmeric *(Curcuma domestica)* and BHT have an equal ability as antioxidant to minimize peroxide formation. BHT as antioxidant is more capable to maintain fat content than 0.9% turmeric *(Curcuma domestica)*.

A prolonged of the storage period may increase moisture content, peroxide formation and to decrease crude fat level. Diet at 4 week of storage period can be given to the animals; however, there is an increase in moisture content, over 50% free fatty acid, peroxide formation and a decrease in fat level.

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