International Journal of Engineering & Technology, 7 (4.38) (2018) 1429-1431

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Role of Dietary Sources of Unsaturated Fatty Acid on Growth Performance, Fat Deposition and Meat Quality of Broiler: A Review

J. Khatun1, 3, T. C. Loh1*, H. Akit1, H. L. Foo2 and R. Mohamad2

1Department of Animal Science, Faculty of Agriculture, 2Department of Bioprocess Technology, Faculty of Biotechnology and Bio-molecular Sciences, Universiti Putra Malaysia, Selangor, Malaysia; and
3Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh.
** Corresponding Author:*
**Corresponding author E-mail: tcloh@upm.edu.my*
; Fax: +60

Abstract

The aims of this paper were to provide a comprehensive review of classification techniques and their alternative approaches in data mining. Classification is a data mining technique that assigns categories to a collection of data to aide in more accurate predictions and analyses. It is one of the several methods intended to make the analysis of very large datasets effective. The goal of classification is to accurately predict the target class for each case in the data. One of the classification approaches is the ensemble method. In recent years, the usage of ensemble method in medical application has been increasing. Not only in medical areas, it can also help researchers to solve modem problems in many fields like machine learning, data mining, and other related areas.

Keywords: *Oil, Unsaturated Fatty Acid, Fat Deposition, Performance and Meat Quality*

1. Introduction

The high growth rate of broiler chickens calls for the use of high-energy feedstuff in their diet. Some of the conventional energy feedstuffs such as maize are very scarce and very expensive. For economic and higher energy content of ration, the broiler should feed with available low cost vegetable fat and oils to supply higher amount of metabolizable energy (ME) at low cost. This justifies the use of dietary fat as a cheap source of energy in the diet of broiler chickens. Moreover, dietary supplementation of polyunsaturated fatty acids reduced abdominal fat in broiler chickens (Wongsuthavas et al. 2008). Diet containing oil rich in unsaturated fatty acid (UFA) has higher metabolizable energy (ME) values due to better intestinal absorption compared to fat rich in saturated fats (Tancharoenrat, 2014). In addition, combination of unsaturated and saturated fatty acids (SFA) could have a synergistic effect on fatty acid absorption (Baião and Lara, 2005). Thus, it is the intent of this review, to synthesize and summarize the information currently available on the sources of plant unsaturated fatty acid for chicken diet as well as to discuss the effects these fatty acids on fatty acid digestion, fat deposition, growth performance and meat quality in broiler chickens.

Fats and oil and their role in broiler nutrition
Fat could be of animal or plant origin. Fat is synonymous to lipid in human food and animal feed. Vegetable oils contain greater amount of unsaturated fatty acids than animal fats and the digestibility of unsaturated fats is about 90 percent. The major aim of using fat and oils in poultry diets is to increase energy density (Sanz et al., 1999). Unsaturated fat supply higher energy due to its higher digestibility compared to saturated fats (Baião and Lara, 2005). Moreover, dietary fats and oils are good sources of essential fatty acids (EFA) such as linolenic and linoleic acids, which are required as precursor for the longer chain polyunsaturated fatty acids (PUFA). Birds unable to synthesize the long chain PUFA due to the lack of enzymes Δ12 and Δ15 desaturase. In addition, dietary oils are major sources of vitamins A, D, E and K. Fats also regulate hormone synthesis in poultry.

2. Dietary sources of essential fatty acid or unsaturated fatty acid in broiler

Vegetable oils represent a potent source of essential fatty acids used in poultry diets. Depending on the fatty acid composition, vegetable oils cause myriad response when use in chickens feed (Abdulla, 2016). Dietary oil containing UFAs/ PUFAs (n-6 and n-3) is effective reducing body fat than SFA. In contrast, saturated fatty acid more interacted towards adipose tissue and less involved in hepatic lipogenesis. The common dietary source of C18 PUFAs are vegetable oils (Palm oil, sunflower oil, corn oil, canola oil, linseed oil), whereas arachidonic acid (C20:4n-6) is one of the PUFAs available in animal fats (Gunstone, 1996).

3. Palm oil

Palm oil is extracted from the mesocarp of the oil palm fruit and contains approximately 50 % oil. Palm oil contains lower amount

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PUFAs (10%) higher proportion SFA (50% SFA) of which rich source of palmitic acid (C16:0) which is approximate 45% of total identified Fatty acids and also contains vitamin E and other anti-oxidants such as lycopenes and ubiquinone (Oguntibeju et al., 2009). Broiler diets supplemented with palm oil had greater abdominal fat and meat oxidative stability compared with those fed soybean oil and linseed oil (Abdulla et al., 2016a; Khatun et al., 2017).

4. Sunflower oil

Sunflower oil is produced from sunflower (Helianthus annuus) seed. It is non-volatile oil and comprises oleic (14–40%), linoleic (48–70%), stearic (1–7%) and palmitic (4–9%). The fatty acid profile of sunflower oil can be influenced by variation in climatic condition and genetic makeup of the plant. Moreover, sunflower oil contains carotenoids, lecithin, waxes and tocopherols, are the characteristics of typical vegetable triacyl glycerol oil. Sunflower oil is liquid in ambient temperature, light in taste and appearance and contains high concentration of vitamin E. Sunflower oil is an attractive source of fat in chicken diets, particularly for layers due to its high content of n-6 PUFAs and sunflower oil is effective to decreased fat deposition in broiler (Sanz et al. (1999).

5. Linseed oil

Flax seed (Linseed) contains approximately 40% of oil which can be used as a component of feed mixtures for poultry. Some flax varieties are rich in α-linolenic acid (C18:3n-3;LNA) while some others in linoleic acid (C18:2n-6; LA). The feeding of linseed oil rich in n-3 PUFA can be an effective method of increasing the tissue levels of these FA in broiler chickens. Abdulla et al. (2015) were found that broilers fed linseed oil had less abdominal fat than those fed palm oil ($P < 0.05$).

6. Canola oil

Rapeseed or canola oil contains 55% of the oleic acid (MUFA) 25% linoleic acid and 10% alpha lenolic acid. María et al (2012) was worked on feeding canola oil of broiler on modifying the composition of fat tissue and found that canola oil increased the content of omega 9 and omega 3 fatty acids and decreased the content of omega 6 fatty acids in meat, fat and plasma in broiler chickens.

7. Influence of dietary fat/ oils on performance and fat deposition of chicken

The excessive fat accumulation of modern broiler is one of the main problems in broiler industry (Zhou et al., 2006) because it is a loss of dietary energy and unacceptable trait for producers and consumers. The quantities of accumulated fat in abdomen differ according to available plasma lipid substrate, which originate from the feed or de novo lipogenesis in the liver. The source and structure of dietary lipids may affect body fat deposition in broiler chickens (Simon et al., 2000). The reduction of fat deposition with the degree of unsaturation might be due to decreased lipogenesis and increased level of lipid break down in body. Dietary sunflower oil decreased fat deposition in chicken compared to tallow (Sanz et al., 1999) in chicken. PUFA rich oil increase fatty acid β-oxidation which indicated that unsaturated fats decrease abdominal fat deposition by stimulating fatty acid β-oxidation, rather than suppressing fatty acid biosynthesis.

8. Effect of dietary fat/ oil on poultry meat fatty acid profile

Dietary source of fatty acid influences the fatty acid concentration in meat of animal. Usually, dietary fatty acids are absorbed and deposited in tissue in monogastic animals without significant modification. Khatun et al. (2017) observed that the fatty acid composition of meat reflected the dietary fatty acid profile and broiler fed palm oil (PO) had significantly higher SFA and lower PUFA in meat than broiler fed sunflower oil. In the same vein, the concentration of palmitic acid, linolenic and linoleic acid increased significantly in breast meat of broilers when diet was supplemented with palm oil, linseed oil and soybean oil respectively (Abdulla et al., 2015). Thus, fatty acid dietary fatty acid composition of diet can modify the fatty acid content of chicken tissue.

9. Effect dietary oil /fat on meat quality of broiler chicken

Meat quality refers to the ability of meat to satisfy a need, its fitness for use, its entire characteristics that make it to satisfy implied or stated need, its ability to meet specified demand and the degree of excellence at reasonable price. Dietary fatty acids can affect the technological and sensory attributes and shelf life of meat (Wood et al., 2008).

10. Meat pH, tenderness, colour, drip loss and cook loss

The postmortem acidification of muscle is an important process that converts muscle to meat and it is measured in terms of pH (Lawrie and Ledward, 2006). Increasing the level of dietary fat decreased chicken breast muscle pH due to increased muscle glycogen level associated with higher yield of breast muscle (Alvarado et al., 2007). Meat tenderness is the most vital characteristic that controls eating satisfaction as well as customer acceptance of meat (Juárez et al., 2012). Meat tenderness is greatly influenced by difference in fatty acids due to variation of melting temperature. The melting temperature of SFA is greater thus appear whiter and firmer than UFA. In addition, variation of structure of fatty acid such as trans and cis form which have different melting point also play a key role on of muscle tenderness (Enser, 1984). Dietary fat can increase meat tenderness by altering deposition of body fat (Wood et al., 2008). Increase in the fat content of the meat can improve tenderness (Wood et al., 2008). It has been also observed that meat color influence by dietary oils, a reduction of color saturation was reported when sheep fed fish oil, marine algae, and their combination compare to sheep fed linseed oil (Lawrie and Ledward, 2006)). However, Marinova et al. (2001) observed no difference in meat color in goats when fed 2.5% sunflower oil and control diet.

The total fat content of meat can affect drip loss and cook loss. Zhang et al. (2011) reported higher drip loss in chickens fed diet inclusion of oxidized oil compare to control could be due to myofibril protein oxidation, which decreased water holding capacity. Dietary supplementation of soybean oil, palm oil and linseed oil had no effect on drip loss of broiler breast muscle (Abdulla, 2016). Studies observed that increased level of fat in meat decreased the loss of water during cooking

11. Shelf-life (lipid oxidation) of meat

The oxidation of lipid during storage and processing is the vital cause of quality deterioration in meat. Meat becomes vulnerable to oxidative spoilage due to presence of higher proportion unsaturat-

ed fats and discoloration, nutrients loss, off flavor, drip loss and toxic compounds formation are the major identified characteristics of oxidative spoilage of meat. Recently, there is an increase in the demand for meat enriched with PUFAs especially n-3 PUFA due to its positive influence on the health of human (Scollan et al., 2014). Nonetheless, meat containing unsaturated fats is susceptible to lipid oxidation, which could reduce the shelf life of the meat. Reduced protein and lipid oxidation was observed in breast meat of broiler chickens fed a diet with antioxidant compared to the breast muscle of broiler chickens fed oxidized oil (Zhang et al., 2011). The supplementation of antioxidants especially vitamin E has been reported to decrease susceptibility to lipid oxidation in pork, beef, and turkey meat (Guo et al., 2001) especially when PUFAs are incorporated into the diets of the animals.

12. Conclusion

High body fat is the economic loss for broiler producer and also it affects the consumer acceptance. Therefore, it is great deal of time to take strategies to reduce body fat deposition in broiler chickens. Dietary intake of plant source of unsaturated fatty acid has been shown to reduce deposition of body fat than the animal fat source and also increase the proportion of UFA in meat. Consuming greater amount of this unsaturated fatty acid (beneficial) rich meat everyday life may reduce cardiovascular diseases (CVD) and possibly the incidence of cancer, asthma and diabetes. However, care need be taken when introducing these fatty acid sources in broiler diets as varying fatty acid compositions of muscle have profound effect on meat quality. The firmness, oiliness and oxidative stability of muscle depend on fatty acid composition of this product and variation in composition may in turn affects flavor and muscle color. Inclusion antioxidant especially Vitamin E in broiler diet can able to stabilizes UFAS/PUFA levels in meat and maintain the quality of meat during processing and storage without any further quality deterioration of meat.

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