

## REVIEW ARTICLE

## DERLEME

## The importance of fats in farm animal nutrition

İbrahim Sadi ÇETİNGÜL<sup>1\*</sup>, Mehmet YARDIMCI<sup>2</sup>

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Departments of  
Animal Nutrition<sup>1</sup> and  
Animal Husbandry<sup>2</sup>  
Faculty of Veterinary Medicine  
Afyon Kocatepe University  
03200-Afyonkarahisar  
T U R K E Y

\* **Corresponding author**  
Tel: 0 272 2281312-169  
Fax: 0 272 2281349  
Email: sadicet@yahoo.com

### S U M M A R Y

Being present in many feedstuffs, fats are one of the most important components of diets. Fat supplements play an important role in improving the absorption of fat soluble vitamins and reducing the powderiness of feed. Natural fats are consists of 3 fatty acids and 1 glycerol components. Fatty acids are usually classified as saturated (SFA), unsaturated (USFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids. Among the polyunsaturated fatty acids group, linoleic (LA) and linolenic (LNA) fatty acids are the essential fatty acids. The fatty acid profile of feed affects the fatty acid composition of the tissues of the animals fed with these diets. This effect occurs in meat and eggs in poultry while it occurs in tissues, milk and embryo development in pigs. Moreover, fat supplements can enhance productive performance in cattle, pigs and poultry. Because of this, there is currently much interest in optimizing the amount and type of fat in diets of farm animals. In the cases where better feed conversion rate and faster growth is aimed, fats should be considered as much important as proteins and carbonhydrates in farm animal nutrition.

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### Yağların çiftlik hayvanlarının beslenmesindeki önemi

#### Ö Z E T

Pek çok hammaddede doğal olarak bulunan yağlar, rasyonun en önemli bileşenlerinden biridir. Yağlar ilave edildikleri rasyonun tozumasını engellemeleri, yağda eriyen vitaminlerin emilimi açısından önemli rol oynarlar. Doğal yağlar bir gliserol ve 3 yağ asidi bileşeninden oluşmaktadır. Yağ asitleri genel olarak doymuş, doymamış, tekli doymamış ve çoklu doymamış yağ asitleri olarak sınıflandırılır. Çoklu doymamış yağ asitlerinden linoleik ve linolenik asitler esansiyel yağ asitleridir. Rasyonun yağ asitleri profili bu rasyonla beslenen hayvanların dokularındaki yağ asitleri kompozisyonunu etkiler. Bu etki kanatlılarda et ve yumurtada görülürken, herbivorlar ve karnivorlarda ise doku, süt ve embriyo gelişimi olarak karşımıza çıkmaktadır. Aynı zamanda rasyona yağ ilavesi ruminantlarda, domuzlarda ve kanatlı ürünlerinde üretim artışları oluşturmaktadır. Bu durum konuyla ilgili sahada yapılan çalışmalarda en ideal artış ortaya çıkartan yağ tipi ve yağ asitleri kompozisyonu tespit üzerine bir arayışı ortaya çıkarmıştır. Neticede artan yemden yararlanma değerleri ve sağlıklı hızlı büyümenin hedeflendiği durumlarda yağlardan proteinler ve karbonhidratlar gibi büyük bir önemle bahsedilmesi gerekmektedir.

## INTRODUCTION

The characteristics of fats have been a research issue for about 200 years for the scientific world since many feed materials contain fat<sup>1</sup>. The main objective in fat supplementation to diets is to increase the energy value as well as avoid a powdery structure.<sup>1,2,3</sup>

The diet of farm animals has been traditionally low in fat, especially in herbivores; not more than 2-5 % of digestible energy. It has been known for some time that fat supplements can enhance productive performance in cattle, pigs and poultry, and there is currently much interest in optimizing the amount and type of fat in the diets of farm animals. Increasing the nutrient density of diets by increasing the fat content, results in increased food conversion efficiency and faster growth in cattle, pigs and poultry.

The differences seen between the qualities of fats come from their fatty acid contents since all the natural fats include glycerol as alcohol. Free fatty acid amount in fats has a low energy activity particularly more in new borns.

The fatty acid profile of the feedstuff influences the fatty acid profile of the tissues. It is difficult to increase the fat which is located inside the muscles by feeding because the fat added to feed primarily accumulates under the skin or in body cavities, then between the muscles and finally inside the muscles.<sup>3</sup> Another advantage of fat usage in diets is its extra caloric effect. The extra caloric effect occurs<sup>1</sup> as the effect of unsaturated fatty acids on facilitating the resorption of saturated fatty acids<sup>2</sup> keeping the oil supplemented diets longer in the digestive truck thus increase the absorption comparing the standard diets.

## SATURATED/UNSATURATED FATTY ACIDS

Almost all of the vegetable oils are in liquid form and rich in terms of unsaturated fatty acids whereas most of the animal fats are in solid form and rich with the saturated fatty acid content.

Since the absorption of the saturated fatty acids from the digestive system is hard, unsaturated fatty acids release more energy than the saturated fatty acids. Mono-unsaturated fatty acids with the same chain length produce more energy than poly-unsaturated fatty acids<sup>2</sup>.

In a study on rats, Bessesen et al.<sup>4</sup> determined that the absorption of the fats in diet was significantly affected by the fat type and feeding conditions and different fatty acids were accumulated inside different tissues. Nicolosi et al.<sup>5</sup>

indicated that the absorption of saturated fatty acids was less than unsaturated fatty acids in hamsters.

According to Rocca et al.<sup>6</sup>, the richness of diet with MUFA is favorable in terms of glycemic control, MUFA, particularly stimulates the releasing of peptide-1 (GLP-1), a glucagon kind antidiabetic hormone and in this way ensures the occurrence of glisemic tolerance. The most common of the MUFA is oleic acid.

Since fats and fatty products can easily be deteriorated by oxidation, this chemical process attracts attention in utilizing fats and fatty seeds. The presence of high oleic acid amount, increases the resistance of fat against oxidation<sup>6,7</sup>. The fact that oleic acid is more resistant to oxidation than LA and has positive effects on human and animal health, led the scientists to improve varieties rich of oleic acid.<sup>8,9</sup> In comparison with oleic acid, LA and LNAs are 12-24 times more resistant to oxidation.<sup>10</sup>

## Trans Fatty Acids

Double bonds are found in 2 different configurations: cis and trans forms. If the substituents are on the same side, cis form occurs. When the substituents are in different side, trans form occurs.<sup>11</sup> The hydrogenization period is accelerated and occurrence of trans fatty acids increases when fats are fried for long time (7-8 hours) in high temperatures (over 185 °C).<sup>9</sup> The studies regarding trans unsaturated fatty acids exhibit that side effects are occurred in case of over consumption.<sup>9,12</sup> Unsaturated trans fatty acids could be more harmful than saturated fatty acids.<sup>13</sup>

## Essential Fatty Acids

Linoleic acid (LA) and linolenic acid (LNO) from the PUFA series are the essential fatty acids for the animal nutrient requirements. The most common of PUFAs is LA,<sup>14</sup> the richest source for LNA are the cold water fish.<sup>15</sup> There is an enzymatic competition for synthesis of poly-unsaturated fatty acids from LA and LNA in the body. Due to this reason, the rate of LA and LNA should be 1-4:1 in diet. Arachydonic acid which is known as essential fatty acid, could be synthesized from LA.<sup>16</sup> The fatty acids acquired from aromatic plants are also defined as essential fatty acids for plants, while the oil acquired from aromatic plants have important usage efficiency with its antioxidant,<sup>17,18</sup> antibacterial,<sup>8,19,20</sup> anti-inflammatory,<sup>21</sup> insecticide,<sup>22</sup> antispasmodic, expectorant, fungicide,<sup>23,24</sup> antivirutic,<sup>25</sup> effects.

## Factors Affecting the Digestion and Absorption of Fats

Adequate amount of bile salt and balanced (3:1) unsaturated/saturated fatty acids are required for maximum absorption of fats.<sup>26</sup> The fatty acid profile and structure of triacylglycerol play an important role in the absorption of fats:<sup>26</sup> The main factors affecting the digestion and absorption of fats are:

- 1- Unsaturated structured fatty acids can be digested and absorbed easier than saturated fatty acids.
- 2- The more the length of the fatty acid chains increase, the harder the absorption realize
- 3- If the structure of the fat source is in fatty acid and triglyceride form, this influences the absorption.
- 4- The location of unsaturated fatty acids as number 2 position on the triglyceride molecule facilitates absorption.
- 5- The more unsaturated/saturated fatty acids rate increases, the more digestion and absorption increases
- 6- The more the rate of cellulose of mix feed which fat is added increases, the more digestion decreases
- 7- The more the fat supplementation to feed increases, the more absorption decreases
- 8- The older the animal becomes, the more digestion and absorption increases.<sup>9,27</sup>

## COMMON EFFECTS OF FATS AND FATTY ACIDS ON FARM ANIMALS

Fatty acid composition of diet was found to change the fatty acid composition of tissues in a 15 days study conducted in pigs.<sup>28</sup> Elmes et al.<sup>29</sup> stated that linoleic acid supplementation to diet during the late pregnancy caused abortions in ewes.

Fat usage in ruminant diets is common, particularly in the need of high energy.<sup>3</sup> The cows fed with high fat content diets are less influenced from the negative effect of the negative energy balance during the early lactation period,<sup>30</sup> and the insuline/somatotropine and insuline/glucagone rates increase. These changes are important in terms of suppressing the lipolysis especially at the early lactation period.<sup>31,32</sup>

Fertility is an important problem in feeding of high production ruminants. There is a strong relationship between fatty acids and reproductive functions. Therefore fatty acids could be utilized in regulating the reproductive functions. Several studies exhibited that, 1- Diets rich from linoleic and arachydonic acids lead a better follicular development and increase the ovulation rate in cow by stimulating the PGF2 $\alpha$  sythesis during the follicular development period.<sup>33,34</sup> 2- Diets rich from linoleic acids should be given to the animals during

the post-ovulation period in order to stimulate the progesterone synthesis and thus improve the conception rates by forming bigger corpus luteum.<sup>33,34</sup> 3-Diets rich from linoleic acid could improve the recognition of gestation by the mother by stimulating the progesterone synthesis.<sup>33,34</sup> When unsaturated fatty acids are saturated by hydrogenization in rumen, the cis and trans fatty acid isomers are seen in milk and meat fats.

The trans formed fatty acids can be present in the tissues of ruminants with a percentage of 4-11 %<sup>11</sup>. Conjugated linoleic acid (CLA) acquired from the milk and meat of ruminants by this way has positive effects on human health.<sup>35,36</sup> The usage of conjugated linoleic acid due to its anticarcinogenic, antiatherogenic effects as well as detractive effects on fattening in humans attracts attention in the recent years.<sup>36,37</sup> The biological synthesis of CLA is made by the microbiological isomerization in ruminants. Therefore ruminants and their products are rich from these kinds of fatty acids. CLA amount quite differs according to the diet contents of ruminants<sup>35</sup>. Using fish oil in ruminant diets decreases the milk fat amount whereas it increases the conjugated linoleic acid amount<sup>38</sup>.

Fatty acids of diet significantly affect the fatty acid composition of products in layer hens<sup>39,40</sup> and broilers.<sup>41-44</sup> It is determined that the internal fat rate decreases as a result of using unsaturated fats instead of using saturated fats in broiler feeds.<sup>45</sup> In another study on breeding broilers, fatty acid content in diet was found to have significant effects on the embryonic development in eggs.<sup>46</sup> Saturated fat supplementation to broiler feeds leads the carcass to be fatter and contain less protein,<sup>47,48</sup> also a linear relationship both between the age of the animal and ME values of fats; and between unsaturation degree of fats and ME values was found.

The relationships between fatty acids used in diets and cholesterol amount in egg have been examined and some of them mentioned significant relationships,<sup>40,49</sup> while some others reported insignificant relationships.

Oil supplemented diets affect the immune system in chicken<sup>50</sup>. The presence of conjugated linoleic acid (CLA), one of the unsaturated fatty acids, in the diets of layer hens has positive effects on immune system<sup>51</sup> and embryonic deaths were seen in hatched eggs when the CLA amount in diet passes beyond 0.5% in quails. The oleic acid richness of diet influences the egg shell quality positively.<sup>52,53</sup>

Another point regarding fats is the relationships between fat type in diet and insulin sensibility in cell membranes.<sup>54</sup>

More studies should be carried out on the relationship of the fatty acid content of diet with genetic and environmental factors.

## CONCLUSION

The importance of fat amount of diet is a matter of concern for long years. As result of the recent

researches, apart from the fat amount, the knowledge of percentages of unsaturated fatty acid, saturated fatty acid and unsaturated/saturated rate as well as amount of some fatty acids such as palmitic, stearic, oleic, linoleic, linolenic, arachidonic acids should be inserted in diets of which is expected to improve the quality ■

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