ABSTRACT
of the Phd Thesis entitled:

Determination and Characterization of the Fatty Acids Profile of Broiler Carcasses under the Influence of Dietary Factors

written by PhD student **Dragoş-Sorin Fota**, Eng., under the scientific guidance of **Prof. Dan Drinceanu Ph.D.**

The F vitamins (essential fatty acids) were discovered in 1929 by George O. Burr, Mildred M. Burr and Elmer S. Miller. In 1932, they describe in the work "*Fatty acids essential in nutrition*" the role of this group of substances, remarking that the lack of polyunsaturated fatty acids from animal food leads to the appearance of some coetaneous disorders, even stunning the growth and the capacity to reproduce. The authors have named the fatty substances blend F vitamins, following the alphabetical order (up until their time, the vitamins A to E have been already discovered), also applying the title of „*essential fatty acids*”. As for the deficiency symptoms, they were considered specific to „*the fat deficiency disease*”.

Only in 1959, 30 years after the first discovery of the F vitamins in 1929, the vitamin action and the “essentiality” of polyunsaturated fatty acids on the human body was demonstrated.

The idea of creating *functional* products was born from the wish to improve life quality, to adopt a healthy life style and in order to be able to prevent or reduce the risk of sickness. *The concept of “functional products”* was launched in the middle of the 80s in Japan by the health authorities and refers to those processed products that have one or more benefits for the organism, besides the nutritional ones.

Functional products include foods that contain certain minerals, vitamins, certain fatty acids or fibers, to which active biological substances, such as antioxidants and probiotics are added.

Producing functional foods represents a challenge for technologists, biochemists, microbiologists as well as nutritionists. With the growing interest in functional foods, there were other new products that appeared and, with them, the need to develop the standards and procedures for development and promotion of these products.

Rodica Segal said “*a functional food can be a natural product, that contains useful components under a biological aspect, or a food obtained through technological intervention that increases the level of active biological components, that are food components that act in a positive manner on some key-functions in the organism, relevant for health.”*

Although sunflower oil is the most common in human alimentation, but also as an energy source in the structure of combined fodder for the majority of species of biotechnological interest, it presents an unbalanced fatty acids profile, thus using it as a single energy source makes obtaining fatty acids ω-3 enriched functional products impossible. In order to obtain *functional* ω-3 products, multiple fatty acids, such as: fish oil (rich in EPA, DPA, DHA fatty acids), spirulin (rich in linolenic fatty acids 1000mg/100g) but also soybean and linseed oil (linolenic ω-3 acid 45-58%, linoleic ω-6 acid 06.0-14%) can be used.

The PhD thesis entitled "**DETERMINATION AND CHARACTERIZATION OF THE FATTY ACIDS PROFILE OF BROILER CARCASSES UNDER THE INFLUENCE OF DIETARY FACTORS"** written by PhD student **Dragoş-Sorin Fota**, Eng., under the scientific guidance of **Prof. Dan Drinceanu Ph.D.,** is made up of two parts, structured on **16 chapters**, to which were added *the general conclusions*, *the recommendations* and the studied bibliography. The thesis has **277** pages, out of which, the first part **BIBLIOGRAPHIC STUDY** is represented by **98** pages 37%, and the second part **PERSONAL RESERCH** contains **165** pages 63% of the entire thesis, having a number of 107 tables, 32 graphics, 11 schemes, 36 figures and 18 de original fotos.

Part I, BIBLIOGRAPFIC STUDY, had six chapters, structured as such:

CHAPTER 1. **CLASSIFICATION AND CHEMICAL STRUCTURE OF LIPIDS** wherein are presented: the chemical properties of lipids, the chemical structure of fatty acids, saturated fatty acids, unsaturated fatty acids and essential fatty acids.

CHAPTER 2. LIPID METABOLISM wherein are presented: the digestion, absorption, transport and lipid deposit mechanisms, the role of the liver in lipid metabolism, the metabolism (anabolism, catabolism) of fatty acids, the metabolism of polyunsaturated fatty acids (PUFA).

CHAPTER 3. BIOCHEMICAL ROLE OF FATTY ACIDS wherein are presented: the conjugated linoleic acid (CLA), linolenic ω-3 acid, arachidonic acid (AA), a derivate of ω-6, the ratio between ω-6 and ω-3 in the body.

CHAPTER 4. LIPID AND MAIN FATTY ACIDS COMPOSITION IN RAW MATERIALS USED IN POULTRY FEED wherein are presented: general considerations, planted raw materials, industrial byproducts, animal forage, vegetable oils and animal fat, specific feed additives.

CHAPTER 5. INFLUENCE POSSIBILITIES OF THE FATTY ACIDS CONTENT IN PRODUCTS OF ANIMAL ORIGIN THROUGH DIETARY FACTORS wherein are rendered the effects of food on polyunsaturated fatty acids (PUFA), the influence of PUFA on body fat distribution, food ingestion, the ω-3 PUFA influence on lipidic metabolism: oxidation and thermo genesis, the influence of *vegetable oils* on the bioproductive indicators and the content in fatty acids of broilers, the influence of *conjugated linoleic acid(CLA)* on bioproductive indicators and fatty acids content in broilers.

CHAPTER 6. PHISICAL, CHEMICAL, ORGANOLEPTIC (SENSORY) AND TECHNOLOGICAL CARACTERISTICS OF POULTRY MEAT wherein are presented the cutting of chicken carcasses and the participation of anatomical parts in their composition, the chemical composition of chicken meat, the physical, organoleptical (sensorial) attributes of chicken meat, the technological attributes of chicken meat, the concept of quality of chicken meat and its influential factors.

Part II, OWN RESEARCH, contains nine chapters, wherein is presented the **purpose** of the thesis, materials and methods used in order to achieve the objectives, the results obtained and the discussions of the conducted research, the general conclusions and recommendations.

In **CHAPTER 7 PURPOSE OF THE THESIS** the purpose and the objective of the present thesis as well as the general experiment organizational scheme is presented.

The present *PhD thesis* has had as objective establishing the possibilities of influencing/modifying the fatty acids profiles with the help of different sources of fatty acids (vegetable oils and CLA – linoleic conjugated acid) as well as balancing the ω-6: ω-3 ratio in broiler carcasses.

Also we have seen if the fatty acids sources influence the bioproductive indicators or the efficiency in slaughtering and the weight of different cut pieces for economical purposes (breast, thigh) from the total in broiler carcasses.

Chapter 8. MATERIALS AND METHODS. The materials and methods used in order to meet the objectives (the methods for: preparing the samples for extracting the fat and determining the fatty acids profile, the analysis of the nutritive content of forage, determining the nutritional and bioproductive indicators in broilers, carcass appreciation and the study of economical efficiency).

Chapter 9. *Experiment I* (August – April 2009) followed the *productive effect and the influence of sunflower oil, soybean oil and linseed oil in a proportion of 2% on the fatty acids profile in broiler carcasses*. The experiment was done on a number of 90 broilers (308 Ross), separated in three experimental groups of 30 chickens/group, having the same base recipe, but different energy sources (fatty acids sources): L1 – sunflower oil, L2 – soybean oil and L3 – linseed oil.

Aim of the experiment: The content in ω-3 linolenic acid is regularly insufficient in lipid sources used in preparing forage in certain growth conditions. This subject constitutes the study of this experiment in which sunflower oil (with a very high content of ω-6 linoleic acid but with a low content of ω-3 linolenic acid), soybean oil and linseed oil (with a very high content of linolenic acid but a low content of linoleic acid) have been introduced in a percentage of 2% in combined fodder for broilers in order to establish and characterize the fatty acids profile in carcasses, the different proportion in different cut pieces, but also in order to highlight the possible differences in regards to nutritive and bioproductive indicators.

Chapter 10. RESULTS AND DISCUTIONS (EXPERIMENT I)

Feed consumption – the data are comparable in all experimental groups. Thus, during the whole growth period, group L1 has registered the highest consumption of 4.40 kg combined fodder/chicken, 1.5% higher than group L2 (4.33 kg) and 1.7% more than group L3 (4.32 kg), group that has registered the lowest consumption.

Body weight – at 42 days, the biggest weight was registered by group L2 (2386g), 5.50% more than group L1 (2367g), but there were no registered statistical differences ($p>0.05$). Based on body weight evolution, the weight gain was determined thus: at 42 days, the average daily gain is comparable at all groups, the highest being registered in L2 (55.86g), followed closely by L3 (55.67g). Regarding the lowest body weight gain, it was established in group L1 (55.40g).

Conversion index – has registered the value of 1.85 (Kg CF/Kg body weight gain) in group L1, 2.4% higher than in groups L2 and L3 1.81 (Kg CF/Kg body weight gain).

Keeping the livestock – during the experiment, it can be seen that the energy source has not influenced this indicator, thus: group L2 that had as an energy source soybean oil has registered the highest percentage of viability (100 %), and groups L1 and L3 that had sunflower oil and linseed oil respectively as an energy source have registered viability percentages between 93.33% and 96.67%.

Slaughter yield – with a percent of 72.04%, group L1 registers the highest efficiency in sacrificing. Lower efficiency is given by groups L2 (71.89%) and L3 (71.81%), in which the energy source was soybean oil and linseed oil, the difference not being influenced by the administered oils.

Percent of cut pieces was established for: breast muscles and thigh, breast and thigh skin, wings, liver and abdominal fat (useful part) and back, throat, breast bone and thigh (rest). By analyzing the useful part and the obtained rest after cutting the carcass, there are statistical differences between L1 and L3 ($p<0.01$) in regards to the rest, ($p<0.05$) in regards to the useful part and between L2 and L3 ($p<0.05$) for the rest as well as for the useful parts.

Regarding the influence of vegetable oils in ***fatty acids*** distribution in cut pieces, it is as follows:

Sunflower oil – rich in ω-6 fatty acids (linoleic acid) and ω-9 (oleic acid), (linolenic acid) but poor in ω-3 fatty acids has determined the following fatty acids distribution: the highest concentration of oleic acid was registered in group L1 in abdominal fat (32.693g), followed by thigh skin (24.807g), breast skin (21.24g), thigh muscles (6.51g), the lowest value being in breast muscles (0.35g); regarding the α-linolenic acid, it keeps the same distribution as the oleic acid: abdominal fat (0.97g), thigh skin (0.60g), breast skin (0.56g), thigh muscles (0.20g), breast muscles (0.008g); following the same distribution, the linoleic acid registers the following values: abdominal fat (28.66g), thigh skin (17.30g), breast skin (15.46g), thigh muscles (5.75g), breast muscles (0.21g); arahidonic acid present the following distribution: abdominal fat (0.40g), breast skin (0.27g), thigh skin (0.25g), thigh muscles (0.09g), breast muscles (0.003g).

We can conclude that the sunflower seed oil, introduced in a percentage of 2% in combined fodder for broilers determines that in the fatty acids profile from the main interest pieces, breast and thigh muscles, big quantities of oleic acid (0.35g/6.50g) and linoleic acid (0.21g/5.75g) are to be found, whereas linolenic (0.008g/0.20g) and arachidonic acids (0.003g/0.09g) are found in lower quantities. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 25.37:1and in thigh is 28.88:1.

Soybean oil – having a higher content of ω-3 fatty acids (linolenic acid) than sunflower oil has determined the following distribution of fatty acids: the highest concentration of oleic acid was established in abdominal fat (31.38 g), followed by thigh skin (21.76 g), breast skin (15.26 g), thigh muscles (5.30 g), the lowest value registering in breast muscles (0.20 g); regarding the α-linolenic acid the following values are registered: abdominal fat (1.33 g), breast skin (0.99 g), thigh skin (0.95 g), thigh muscles (0.30 g), breast muscles (0.01 g); linoleic acid keeps the same distribution as the oleic acid: abdominal fat (23.77 g), thigh skin (16.71 g), breast skin (11.98 g), thigh muscles (4.26 g), breast muscles (0.16 g); arahidonic acid has the following distribution: abdominal fat (0.09 g), thigh skin (0.054 g), breast skin (0.052 g), thigh muscles (0.02 g), breast muscles (0.0003 g).

By concluding the above, we can say that soy bean seed oil introduced in a percentage of 2% in combined fodder for broilers determines that in the fatty acids profile from the main pieces of interest, breast and thigh muscles, relatively large quantities of oleic acid (0.20g/5.30g) and linoleic acid (0.16g/4.2g), and lower quantities of linolenic acid (0.013g/0.30g) and arachidonic acid (0.0003g/0.023g) can be found. The ratio between

linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 11.73:1, and in thigh muscles is 13.56:1.

Linseed oil – rich in ω-3 (linolenic acid) but poor in ω-6 (linoleic acid) and ω-9 (oleic acid), has determined the following fatty acids distribution: oleic acid has registered a decreasing distribution from abdominal fat (29.85g), to thigh skin (18.85g), breast skin (18.14g), thigh muscles (4.34g), the lowest value registering in breast muscles (0.15g);regarding the α-linolenic acid the distribution was as follows: abdominal fat (7.54g), breast skin (4.78g), thigh skin (4.53g), thigh muscles (1.02g), breast muscles (0.03g); following the same distribution as the α-linolenic acid, the linoleic acid, registers the following values: abdominal fat (23.22g), breast skin (14.37g), thigh skin (13.40g), thigh muscles (3.42g), breast muscles (0.12g). Keeping the distribution of the two above mentioned acids, arahidonic acid registers the following concentrations: abdominal fat (0.08 g), breast skin (0.06g), thigh skin (0.04g), thigh muscles (0.007g), breast muscles (0.0004g).

In contrast to sunflower seed oil and soy bean seed oil, linseed oil, introduced in a percentage of 2% in combined fodder for chickens determines that in the fatty acids profile from the main pieces of interest, breast and thigh muscles, there are large quantities of linolenic acid (0.037g/1.02g) and arachidonic acid (0.0004g/0.0073g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 3.32:1, and in thigh is 3.35:1.

Economical efficiency – analyzed through the prism of the production indicator (IP) used in Romania, the highest value was registered by group L3 (257.19), the lowest value being in group L1 (234.85); regarding the European efficiency factor (EEF), the highest value was registered by group L2 (328.52), and the lowest value was registered by group L1 (301.65).

Chapter 11. ***Experiment II*** (September 2009 – January 2010) followed the *productive effect and the influence of soybean oils, linseed oils and sunflower oils, with and without 1% CLA addition (60%) on the fatty acids profile of broiler carcasses.* The experiment was conducted on a number of 120 broiler chickens (308 Ross) separated in four experimental groups of 30 chickens/group, having the same base recipe, but with different energy sources (fatty acids sources) and 1% CLA. Thus, in L2 – sunflower oil + 1% CLA, L3 – soybean oil + 1% CLA, L4 – linseed oil + 1% CLA, with the exception of group L1, that had as an energy source sunflower oil, same as L2, but without the added 1% CLA.

Aim of the experiment: By knowing the effects of Conjugated Linoleic Acid (CLA) on the human body (anti cancer effect, cardiac system protection) and the demand on the market for different products enriched with different substances (fatty acids) an experiment was conducted in which the CLA effect was followed in association with three lipid sources (sunflower oil, soybean oil and linseed oil) on the main nutritive and bioproductive indicators but also on the modifications occurred in fatty acids profile in broiler carcasses.

The research done during this experiment target the possibility of accumulating CLA and obtaining an optimal ω-6: ω-3 ratio (linoleic:linolenic) in chicken carcasses through food factors.

Chapter 12. RESULTS AND DISCUTIONS (EXPERIMENT II)

Feed consumption – the data are comparable in all experimental groups, thus, during the whole growing period group L1 registered a consumption of 3.82 kg combined fodder/chicken, 2.2% more than group L2 (3.14 kg), 4.8% more than group L4 (3.64 kg) but 0.2% less than L3 (3.83 kg).

Body weight – at 42 days, the body weight is comparable in all experimental groups, the biggest weight being registered in group L3 (2248g), 0.50% more than in group L1 (2335g), but there were no statistical differences registered ($p>0.05$).

Based on body weight evolution the gain in weight could be determined thus: at 42 days, the highest average daily gain was registered by L1 (69.73g), 7.5% more than in L3 (64.50 g) and 15.18% more than in L2 (59.14g). The lowest body weight gain was registered by L4 (46.57g), 33.21% less than L1.

Conversion index – it registered a value of 1.85 (Kg CF/Kg body weight gain) in group L1, 8.9% more than L2 1.69 (Kg CF/Kg body weight gain), 7.88% more than L3 1.71 (Kg CF/Kg body weight gain) and 4.8% more than L4 1.76 (Kg CF/Kg body weight gain).

Keeping the livestock – in the case of this experiment, it can be said that CLA has not influenced this indicator: groups L2 and L4, that had as an energy source sunflower oil+1% CLA, and linseed oil+1% CLA respectively have registered the highest viability percentage (100%) and groups L1 and L3 have registered a 96.67% viability percentage.

Slaughter yield – with a percentage of 76.63%, group L3 registered the highest sacrifice efficiency. Lower efficiencies were registered in groups L4 (75.39%), L2 (74.95%) and L2 (74.11%).

Percent of cut pieces was established for: breast muscles and thigh, breast and thigh skin, wings, liver and abdominal fat (useful part) and back, throat, breast bone and thigh (rest). By analyzing the useful part and the obtained rest after cutting the carcass, there are statistical differences between L1 and L4 ($p<0.05$) in regards to the rest, ($p<0.001$) in regards to the useful part and between L2 and L4 ($p<0.001$) for the useful parts, between L3 and L4 ($p<0.05$) for the useful parts.

Regarding the ratio of breast muscles the data are comparable in all groups, with the exception of L4 (25.09%) which registered the lowest percentage; the ratio of thigh muscles from the groups with 1% CLA added 60% (L2 20.81%; L3 19.73%; L4 19.67%) is higher than in group L1 (18.33%).

Regarding the influence of the CLA on ***fatty acids*** in cut pieces, they had the following distribution:

Sunflower oil – is the cheapest and most used energy source, it is rich in ω-6 s (linoleic acid) and ω-9 (oleic acid) fatty acids, but poor in ω-3 (linolenic acid) fatty acids has determined the following fatty acids distribution: the highest concentration of oleic acid was registered in abdominal fat (32.77 g), followed by thigh skin (24.79 g), breast skin (21.23 g), thigh muscles (6.58 g), the lowest value registering in breast muscles (0.35 g); regarding the α-linolenic acid, it presents the following distribution: abdominal fat (0.92 g), thigh skin (0.59 g), thigh muscles (0.18 g), breast skin (0.15 g), breast muscles (0.008 g); the linoleic acid keeps the same distribution as the oleic acid, i.e.: abdominal fat (28.70 g), thigh skin (17.35

g), breast skin (15.51g), thigh muscles (5.74g), breast muscles (0.21 g); the arahidonic acid presents the following distribution: abdominal fat (0.39g), breast skin (0.27g), thigh skin (0.23 g), thigh muscles (0.08 g), breast muscles (0,003 g).

In very small quantities were also determined the two isomers of CLA (vaccenic) i.e.: 9,11 trans-vaccenic acid had the following distribution: breast skin (0.05 g), abdominal fat (0.04 g), thigh skin (0.03 g), thigh muscles (0.01 g) breast muscles (0.0008 g); 10,12cis-vaccenic acid registered the following concentrations: breast skin (0.03 g), abdominal fat (0.01 g), thigh muscles (0.004 g), breast muscles (0.0002 g), it was not detected in thigh skin.

In conclusion to the above considerations we can say that sunflower seed oil introduced in a percentage of 2% in combined fodder for broilers determined that in fatty acids profile from the main pieces of interest, thigh and breast muscles, are found large quantities of oleic (0.35g/6.58g) and linoleic acids (0.21g/5.7g), and the linolenic (0.008g/0.18g) and arachidonic acids (0.003g/0.08g) are in smaller quantities. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 25.43:1, and in thigh is 30.71:1.

Sunflower oil+1%CLA – has determined the following fatty acids distribution: the highest concentration of oleic acid was registered in abdominal fat (25.73g), followed by thigh skin (15.53 g), breast skin (14.93 g), thigh muscles (4.70 g), the lowest value registering in breast muscles (0.20 g); regarding α-linolenic acid it presents the following distribution: abdominal fat (0.87 g), thigh skin (0.44 g), breast skin (0.40 g), thigh muscles (0.14 g), breast muscles (0.006 g); linoleic acid registers the following concentrations: abdominal fat (26.26 g), breast muscles (18.86 g), thigh skin (13.19 g), breast skin (12.40 g), thigh muscles (4.18 g); arahidonic acid presents the following distribution: abdominal fat (0.15 g), thigh skin (0.07 g), breast skin (0.06 g), thigh muscles (0.03 g), breast muscles (0.0002 g).

The added 1% CLA has determined that the two isomers of the CLA (vaccenic) register a higher concentration than in the case of group L1:

9,11 trans-vaccenic acid had the following distribution: abdominal fat (2.88 g), thigh skin (1.42 g), breast skin (1.32 g), thigh muscles (0.44 g), breast muscles (0.02 g).

10,12 cis-vaccenic acid registered the following concentrations: abdominal fat (1.95 g), thigh skin (1.02 g), breast skin (0.98 g), thigh muscles (0.32 g), breast muscles (0.01 g).

Concluding the above, we can say that sunflower seed oil in a proportion of 2% + 1% CLA in combined fodder for broilers, determines that in fatty acids profile from the main pieces of interest, breast and thigh muscles, there are higher quantities of oleic (0.20g/4.70g) and linoleic acids (18.86g/4.18g) and lower concentrations of linolenic (0.006g/0.14g) and arachidonic acids (0.0002g/0.03g). Regarding the two CLA isomers, they have registered higher concentrations than in the case of group L1 (sunflower oil), i.e.: 9.11 trans (0.02g/0.44g) and 10.12 cis (0.01g/0.32g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 27.77:1, and in thigh is 29.67:1.

Soybean oil+1%CLA

The highest concentration of oleic acid was registered in abdominal fat (26.40 g), followed by thigh skin (16.64 g), breast skin (14.10 g), thigh muscles (4.22 g), the lowest value registering in breast muscles (0.15 g); α-linolenic acid presents the following distribution: abdominal fat (1.67 g), thigh skin (1.10 g), breast skin (0.92 g), thigh muscles (0.25 g), breast muscles (0.009 g); linoleic acid keeps in this case also the same distribution as the oleic acid i.e.: abdominal fat (20.23g), thigh skin (12.80 g), breast skin (11.08 g), thigh muscles (3.28 g), breast muscles (0.11 g); arahidonic acid presents the following distribution: abdominal fat (0.08 g), thigh skin (0.06 g), breast skin (0.04 g), thigh muscles (0.01 g), breast muscles (0.0002 g).

Together with the 1% added CLA were determined the two isomers of CLA (vaccenic) i.e.: 9.11 trans-vaccenic acid had the following distribution: abdominal fat (2.23 g), thigh skin (1.45 g), breast skin (1.26 g), thigh muscles (0.35 g) breast muscles (0.01 g); 10.12 cis-vaccenic acid registered the following concentrations: abdominal fat (1.49 g), thigh skin (0.97 g), breast skin (0.85 g), thigh muscles (0.25 g), breast muscles (0.009 g).

Concluding the above we can say that soy bean seed oil introduced in a percentage of 2% + 1% CLA in combined fodder for broilers determined that in the profile of fatty acids in the main pieces of interest, thigh and breast muscles, there are large quantities of oleic (0.15g/4.22g) and linoleic acids (0.11g/3.28g) and linolenic (0.009g/0.25g) and arachidonic acids (0.0002g/0.01g) were present in lower quantities. Regarding the two CLA isomers, they registered lower concentrations than in case of group L2 (sunflower oil +1% CLA) i.e.: 9.11 trans (0.01g/0.035g) and 10.12 cis (0.009g/0.25g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 11.73:1, and in thigh is 13.01:1.

Linseed oil +1%CLA – is rich in ω-3 (linolenic acid) fatty acids but poor in ω-6 (linoleic acid) and ω-9 (oleic acid) fatty acids; this determined the following distribution of fatty acids: oleic acid registered a decreasing distribution in abdominal fat (25.09 g), in thigh skin (16.11 g), breast skin (15.78 g), thigh muscles (3.61 g), the lower value being registered in breast muscles (0.13 g).

Regarding α-linolenic acid the distribution was as follows: abdominal fat (6.44 g), breast skin (4.12 g), thigh skin (3.77 g), thigh muscles (0.79g), breast muscles (0.03 g). Linoleic acid follows this time to the distribution of the α-linolenic acid registering the following values: abdominal fat (20.08g), breast skin (12.60 g), thigh skin (11.35 g), thigh muscles (2.54 g), breast muscles (0.09 g).

Keeping the distribution of the two acids described above, the arahidonic acid registered the following concentrations: abdominal fat (0.07 g), breast skin (0.05 g), thigh skin (0.03 g), thigh muscles (0.005 g), breast muscles (0.0003 g).

Together with the 1% added CLA the two isomers of CLA (vaccenic) were determined i.e.: 9.11 trans-vaccenic acid had the following distribution: abdominal fat (2.75 g), breast skin (1.77 g), thigh skin (1.67 g), thigh muscles (0.36 g), breast muscles (0.01 g); 10.12 cis-vaccenic acid registered the following concentrations: abdominal fat (1.81 g), breast skin (1.13 g), thigh skin (1.11 g), thigh muscles (0.28 g), breast muscles (0.01 g).

In contrast to sunflower seed oil and soy bean oil, linseed oil determines that in fatty acids profile from the main pieces of interest, breast and thigh muscles, there are large quantities of linolenic (0.03 g/0.079 g) and arachidonic acids (0.0003 g/0.005 g). Regarding the two CLA isomers, they have registered lower concentrations than in the case of group L2 (sunflower oil + 1% CLA), i.e.: 9.11 trans (0.01 g/0.036 g) and 10.12 cis (0.01 g/0.28 g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 3.10:1, and in thigh is 3.21:1.

Economical efficiency – analyzed through the prism of the production indicator (PI) used in Romania the highest value was registered by group L1 (393.62), the lowest value being registered by group L4 (264.31); regarding the European Efficiency Factor (EEF), the highest value was registered in group L2 (313.24) and the lowest in group L4 (279.38).

Chapter 13. _**Experiment III**_ (April - August 2010) followed the *productive effect and the influence of four different blends of sunflower oil, soybean oil and linseed oil in a total ratio of 2% on the fatty acids profile in broiler carcasses.* The experiment was conducted on a number of 120 broilers (Ross 308) separated in four experimental groups with 30 chickens/group, having the same base recipe, but different oils blends and proportions: L1 0.5% sunflower oil+ 1.5% soybean oil, L2: 1.5% sunflower oil+ 0.5% soybean oil, L3: 0.5% sunflower oil+ 0.5% soybean oil+ 1% linseed oil, L4: 1.5% sunflower oil+ 0.5% linseed oil.

In order to harmonize fatty acids profiles from broiler carcasses, several vegetable oils can be combined in different proportions so that the ratio of linoleic acid:linolenic acid and ω-6:ω-3 is the closest to the recommended one by some nutritionists (1/2:1).

This theme represents the study of this experiment in which, by combining sunflower oil, soybean oil and linseed oil, they were introduced in a total ratio of 2% in combined fodder for broilers in order to establish and characterize the fatty acids profile in carcasses, the ratio of different cut pieces from the carcass, but also to highlight the possible differences regarding the nutritive and bioproductive indicators.

Chapter 14. RESULTS AND DISCUTIONS EXPERIMENT III

Feed consumption - during the entire growth period group L1 registered the highest consumption, of 3.04 kg combined fodder/chicken, 4.21% more than group L2 (2.91 kg) and 12.65 % more than group L4 (2.67 kg), group which registered the lowest consumption, i.e. 8.44% lower than L2.

Body weight – at 42 days the biggest weight was registered in group L1 (2103g), 0.9% more than in group L2 (2084g) and 4.89% more than group L4 (2001 g) which has registered the lowest weight, 3.98% less than L2.

Based on the body weight evolution, the weight gain could be determined as follows: at 42 days, the highest body weight gain was registered by L2 (82.42g), followed by L3 (72.70g). Regarding the lowest daily average gain, it was seen in group L1 (56.15g), 31.78 % less than in group L2.

Conversion index – registered the same value of 1.44 (Kg CF/Kg body weight gain) in groups L1 and L3, 3.47% more than in L2 and 7.91% more than in L4 1.33 (Kg CF/Kg body weight gain).

Keeping the livestock – in the case of this experiment it can be observed that the blend of oils has not influenced this indicator, thus: group L4 had as energy source the blend made up of 1.5% sunflower oil+0.5% linseed oil and registered the highest viability percentage (100%), followed by L2 with 93.33% and the groups L1 and L3 registered the lowest viability percentage, of 90%.

Slaughter yield – with 72.20%, group L2 registered the highest slaughtering efficiency, and the lowest efficiency was registered in group L3, with 71.80%, the difference not being influenced by the blends of oils.

Percent of cut pieces was established in breast and thigh muscles, breast and thigh skin, wings, liver and abdominal fat (useful part) and back, throat, breast and thigh bone (the rest). By analyzing the useful part and the rest obtained after cutting process of the carcass, there are statistical differences between L1 and L2 ($p<0.05$) in the case of the rest, ($p<0.01$) and useful part, between L1 and L3 ($p<0.01$) for the useful part but also between L1 and L4 ($p<0.05$) in the case of the useful part, between L2 and L4 ($p<0.05$) regarding the useful part.

Regarding the influence of vegetable oils blends on the distribution of ***fatty acids*** determined in the cut pieces, it is as follows:

Sunflower oil 0.5%+soybean oil 1.5% – the blend tries to balance the ratio ω-6:ω-3 by lowering the proportion of sunflower oil participation.

The highest concentration of oleic acid was registered in thigh (32.36 g), followed by abdominal fat (32.34 g) and breast (26.01 g); regarding linolenic acid, it registers the following concentrations: abdominal fat (2.05 g), followed by thigh (1.95 g) and breast (1.63 g); following the same distribution as the linoleic acid, it registered the same values: abdominal fat (31.48 g), thigh (28.62 g) and breast (26.97 g).

In conclusion, we can say that the blend between sunflower seed oil and soy bean oil introduces in a total ratio of 2% in combined fodder for broilers determines that in the fatty acids profile from the main pieces of interest, breast and thigh, there are in large quantities oleic (26.01g/32.36g) and linoleic acids (26.97g/28.62g) and in lower quantities linolenic acid (1.63g/1.95g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 16.54:1, and in thigh is 14.67:1.

The blend of sunflower oil 1.5%+soybean oil 0.5% – has determined the following distribution of fatty acids: the highest concentration of oleic acid was established in thigh (32.57g), followed by abdominal fat (31.58g) and breast (28.14g); regarding linolenic acid the following values are registered: in abdominal fat (1.246g), breast (1.240g) and thigh (1.18g); linoleic acid presents the following distribution: abdominal fat (31.56g), followed by thigh (30.06g) and breast (29.17g).

By concluding the above we can say that the blend introduced in a total ratio of 2 % determines that in the fatty acids profile of the main pieces of interest, breast and thigh, there are large quantities of oleic (28.14g/32.7g) and linoleic acids (29.17g/30.06g), but low concentrations of linolenic acid (1.24g/1.18g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 23,52:1, and in thigh is 25,48:1.

The blend of sunflower oil 0.5%+soybean oil 0.5%+linseed oil 1% – intended to increase the quantity of ω-3 fatty acids (linolenic acid) available and determined the following distribution of fatty acids: oleic acid registered a decreasing distribution in abdominal fat (35.17 g), followed by thigh (34.93g), and in breast (34.80 g); regarding linolenic acid the distribution was as follows: in abdominal fat (5.22g), thigh (5.08 g), and breast (5.03 g); following the same distribution as the two acids described above, linoleic acid, registered the following values: in abdominal fat (28.55g), thigh (28.01 g), and breast (27.59 g).

In contrast to the other blends, this one determines that in the fatty acids profile from the main interest pieces, breast and thigh, the acids will present an uniform distribution, the quantitative differences between pieces being reduced thus: oleic acid (34.80g/34.93g), linoleic acid (27.59g/28,.1g) and linolenic acid (5.03g/5.08g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 5.48:1, and in thigh is 5.51:1.

Through the blend of sunflower oil 1.5%+linseed oil 0.5% – it was intended to increase the quantity of ω-3 fatty acids (linolenic acid) available and determined the following distribution of fatty acids: oleic acid registered the following distributions: in breast (35.81 g), followed by abdominal fat (35.61 g), and thigh (33.25 g); regarding linolenic acid the distribution was: in thigh (3.87 g), abdominal fat (3.60 g), and breast (3.52 g); following the same distribution as the linolenic acid, the linoleic acid, registered the following values: thigh (29.48 g), abdominal fat (26.24 g), and breast (25.75 g).

As the previous blend, this one determines the same uniform distribution of fatty acids in the main pieces of interest, breast and thigh, the quantitative differences between the pieces being reduced thus: oleic acid (35.81g/33.25g), linoleic acid (25.75g/29.40g) and linolenic acid (3.52g/3.87g). The ratio between linoleic acid (ω-6):linolenic acid (ω-3) in pectoral muscles is 7.31:1, and in thigh is 7.62:1.

Economical efficiency – analyzed through the production indicator (PI), used in Romania, the highest value was registered by group L2 (537.92) and the lowest value registered by group L1 (342.40); regarding the European Efficiency Factor (EEF), the highest value was registered in group L4 (349.73) and the lowest in group L3 (291.69).

Chapter 15. *Experiment IV* (September 2010-January 2011) followed *the productive effect and the influence of bought sunflower oil – refined and cold pressed – unrefined in a 4% ratio on the fatty acids profile in broiler carcasses*. The experiment was conducted on a number of 90 broilers (Ross 308) separated in three experimental groups with 30 chickens/group, having the same base recipe, but different energy sources (fatty acids sources) for group L1 –refined sunflower oil, L2- unrefined sunflower oil and a blend for group L3- 2% refined sunflower oil +2% unrefined sunflower oil.

Aim of the experiment: Sunflower oil has a high content of ω-6 linoleic fatty acids and a very low content of ω-3 linolenic fatty acids in the case of unrefined oil, pressed cold, while in refined bought oil, obtained through chemical extraction the linolenic acid disappears; so, used as an energy source the two types could determine some qualitative and/or quantitative differences regarding the content of fatty acids in broiler carcasses.

The study of this experiment consist in using unrefined cold pressed sunflower oil and refined sunflower oil obtained through chemical extraction, in a 4% ratio in combined fodder for broilers in order to establish and characterize the fatty acids profile in carcasses, the ratio of different cut pieces from the carcass, but also in highlighting the possible differences regarding the nutritive and bioproductive indicators.

Chapter 16. RESULTS AND DISCUTIONS (EXPERIMENT IV)

Feed consumption – during the entire growth period, group L1 registered the highest consumption, of 4.05 kg combined fodder/chicken, 22.89% more than group L2 (3.13 kg) and 21.18 % more than group L3 (3.19 kg) group which registered the lowest consumption.

Body weight – at 42 days, the biggest weight was registered by group L3 (2398 g), 1.2% more than in group L1 (2364 g) but there were no statistical differences registered ($p>0.05$).

Based on body weight evolution, the weight gain could be determined thus: at 42 days the highest body weight gain was registered by L3 (85.58 g) followed closely by L2 (75.60 g). Regarding the lowest daily average gain, it was registered by L1 (62.11 g) 27.4% less than L3.

Conversion index – registered a value of 1.71 (Kg CF/Kg body weight gain) in group L1, 23.40% more than group L2 1.31 (Kg CF/Kg body weight gain) and 22.23% more than L3 1.33 (Kg CF/Kg body weight gain).

Keeping the livestock – in the case of this experiment, it can be seen that the energy source did not influence this indicator. Thus: groups L1 and L2 had the highest viability percentage (93.34%), and group L3 registered a viability percentage of 90%.

Slaughter yield – with a percentage of 72,33% group L2 registered the highest sacrifice efficiency, lower efficiencies being registered in L1 (72.16%) and L3 (71.83%), in which the energy source was represented by refined sunflower oil and 2% sunflower oil refined +2% unrefined sunflower oil blend respectively, the difference not being influenced by the oils.

Percent of the cut pieces was established in thigh and breast muscles, breast skin and thigh, wings, liver and abdominal fat (useful parts) and back, throat, breast and thigh bone (the rest). By analyzing the useful part and the rest obtained after cutting the carcass, there are statistical differences between L1 and L3, L2 and L3 ($p<0.05$) for the rest.

Regarding the influence of the fatty acids source (vegetable oils) on the distribution of ***fatty acids*** determined after cutting, it was as follows:

Refined sunflower oil – rich in ω-6 fatty acids(linoleic acid) and ω-9 fatty acids (oleic acid), but poor in ω-3 fatty acids (linolenic acid) it determined the following fatty acids distribution: the highest concentration of oleic acid was registered in abdominal fat (34.69 g), followed by thigh (30.19 g) and breast (24.81 g); regarding linolenic acid, it registered the following values: in thigh (0.66g) followed by abdominal fat (0.64 g) and breast (0.60 g), following the same distribution as the oleic acid, linoleic acid registers the following concentrations: in abdominal fat (34.47 g), followed by thigh (23.17 g) and breast (21.82 g).

By concluding the above we can say that refined sunflower seed oil introduced determines that in the fatty acids profile for the main pieces of interest, breast and thigh there are large quantities of oleic acid (24.81g/30.19g), linoleic acid (21.82g/23.17g), and linolenic acid (0.60g/0.66g), in lower quantities. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 36.36:1, and in thigh is 35.12:1.

Unrefined sunflower oil – having a higher content of ω-3 fatty acids (linolenic acid) in comparison to refined sunflower oil determined the following distribution of fatty acids: the highest concentration of oleic acid was established in abdominal fat (35.76 g), followed by thigh (32.32 g), the lowest value being registered in breast (30.11 g); regarding linolenic acid the following values are registered: abdominal fat (0.66 g), thigh (0.63 g) and breast (0.60 g); linoleic acid keeps the same distribution as oleic acid: abdominal fat (30.32 g), thigh (23.08 g), breast (28.16 g).

By analyzing the above, we can say that unrefined sunflower seed oil introduced in a ratio of 4 % in combined fodder for broilers determines that in fatty acids profile from the main pieces of interest, breast and thigh there are similar quantities with the ones obtained in the case of refined sunflower seed oil, i.e.: large quantities of oleic acid (30.11g/32.32g), linoleic acid (28.08g/29.08g) and linolenic acid (0.60g/0.630g). The ratio between linoleic acid (ω-6):linolenic acid (ω-3) in pectoral muscles is 48.55:1, and in thigh is 46,15:1.

The blend of 2% refined sunflower oil +2% unrefined sunflower oil – determined the following distribution of fatty acids: oleic acid accumulated in a larger quantity in abdominal fat (36.70g), followed by thigh (33.46g) and breast (26.48g); regarding linolenic acid the distribution was as follows: abdominal fat (0.73g), followed by thigh (0.72g), the lowest value registering in breast (0.46g); linoleic acid registered the following values: thigh (23.85g), breast (22.82g) and abdominal fat (21.37g).

The blend of refined and unrefined sunflower oil introduced in a total ratio of 4 % in combined fodder for broilers determines that in the fatty acids profile from the main pieces of interest, breast and thigh, there are relatively similar quantities of oleic acid (26.48g/33.46g), linoleic acid (22.82g/23.85g) and linolenic acid (0.46g/0.72g) as in the case of using refined or unrefined sunflower oil. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 49.60:1, and in thigh is 33.12:1.

Economical efficiency – analyzed through the production indicator (PI) used in Romania the highest value was registered by group L3 (565.33), the lowest value registering in group L1 (330.50); regarding the European Efficiency Factor (EEF) the highest value was registered in group L2 (394.24), and the lowest in group L1 (299).

GENERAL CONCLUSIONS

Experiment I,

From presenting the ***nutritive and bioproductive indicators*** (forage consumption, body weight, the conversion index, keeping the livestock, the slaughtering efficiency, percent of cut pieces) it appears that none was significantly influenced by the type of oil used (sunflower, soybean and linseed oils).

Regarding the influence of vegetable oils on the distribution of ***fatty acids*** determined in cut pieces, we can say the following:

Sunflower oil introduced in a ratio of 2% in combined fodder for broilers determines that in the fatty acids profile from the main interest pieces, breast and thigh muscles, there are large quantities of oleic acid (0.35g/6.50g) and linoleic acid (0.21g/5.75g), and in lower quantities linolenic acid (0.008g/0.20g) and arachidonic acid (0.003g/0.09g). The ratio between linoleic acid (ω-6):linolenic acid (ω-3) in pectoral muscles is 25.37:1and in thigh is 28.88:1.

Soybean oil introduced in a ratio of 2% in combined fodder for broilers determines the fact that in the fatty acids profile from the main interest pieces, breast and thigh muscles, there are large quantities of oleic acid (0.20g/5.30g) and linoleic acid (0.16g/4.26g), but lower concentrations of linolenic (0.013g/0.30g) and arahidonic acids (0.0003g/ 0.023g). The ratio between linoleic acid (ω-6):linolenic acid (ω-3) in pectoral muscles is 11.73:1, and in thigh muscles is 13.56:1.

Linseed oil introduced in a ratio of 2% unlike sunflower and soybean oil in combined fodder for broilers determines that in the fatty acids profile from the main interest pieces, breast and thigh muscles, there are large quantities of linolenic acid (0.037g/1.02g) and arahidonic acid (0.0004g/0.0073g). The ratio between linoleic acid (ω-6):linolenic acid (ω-3) in pectoral muscles is 3.32:1, and in thigh is 3.35:1.

It can be thus seen that by using linseed oil, it influences in a significant way the ω-6:ω-3 ratio, which allows its recommendation in the structure of combined fodder for broilers; also, it is preferable to use soybean oil instead of sunflower oil in a ratio of 2%.

In conclusion, it can be said that from a 2% ratio of participation in the combined fodder, the type of oil can influence the fatty acids profile in broiler carcasses.

Experiment II,

Regarding the ***nutritive and bioproductive indicators*** (forage consumption, body weight, the conversion index, keeping the livestock, the slaughtering efficiency, percent of cut pieces) we can say that only feed consumption was significantly influenced, thus the chickens from group L2 with added CLA (2% sunflower oil + 1% CLA) have registered a lower consumption than the chickens in group L1, without added CLA (2% sunflower oil).

Regarding the influence of CLA on ***fatty acids*** determined in cut pieces, they had the following distribution:

Sunflower oil introduced in a ratio of 2 % in combined fodder for broilers determines that in the fatty acids profile for the main interest pieces, breast and thigh muscles, there are large quantities of oleic acid (0.35g/6.58g), linoleic acid (0.21g/5.74g), and linolenic (0.008g/0.18g) and arahidonic acids (0.003g/0.08g) are found in lower quantities. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 25.43:1, and in thigh is 30.71:1.

Sunflower oil in a ratio of 2% + 1% CLA in combined fodder for broilers determines that in the fatty acids profile for the main interest pieces, breast and thigh muscles, there are large quantities of oleic acid (0.20g/4.70g) and linoleic acid (18.86g/4.18g) to the detriment of linolenic (0.006g/0,14g) and arahidonic acids (0.0002g/0.03g). Regarding the two CLA isomers they have registered larger concentration than in group L1 (sunflower seed oil) i.e.: 9.11 (0.02g/0.44g) and 10.12 (0.01g/0.32g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 27.77:1, and in thigh is 29.67:1.

Soybean oil introduced in a ratio of 2 % +1% CLA in combined fodder for broilers determines that in the fatty acids profile for the main pieces of interest, breast and thigh muscles, there are large quantities of oleic acid (0.15g/4.22g), linoleic acid (0,11g/3,28g) and the linolenic (0.009g/0.25g) and arahidonic acids (0.0002g/0.01g) were present in lower quantities. Regarding the two CLA isomers, they have registered higher concentrations than in the case of group L1 (sunflower oil) i.e.: 9.11 trans (0.01g/0.035) and 10.12 cis (0.009g/0.25g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 11.73:1, and in thigh is 13.01:1.

Linseed oil introduced in a ratio of 2 %. + 1% CLA in combined fodder for broilers, unlike sunflower and soybean oil determines that in the fatty acids profile for the main pieces of interest, breast and thigh muscles, there are large quantities of linolenic (0.03g/0.79g) and arahidonic acids (0.0003g/0.005g). Regarding the two CLA isomers, they have registered higher concentrations than in the case of group L1 (sunflower seed oil) i.e.: 9.11 trans (0.01g/0.036) and 10.12 cis (0.01g/0.28g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 3.10:1, and in thigh is 3.21:1.

It can be thus concluded that using linseed oil in combination with CLA influences significantly the ratio between linolenic and linoleic acids, which permits its recommendation in the structure of combined fodder for broilers; also, it is preferred the use of soybean and linseed oil in combination with CLA instead of sunflower oil.

In conclusion, we can say that from 1% CLA can influence the profile of ω-6, ω-3 and ω-9 fatty acids in broiler carcasses.

Experiment III,

Regarding ***the nutritive and bioproductive indicators*** (feed consumption, body weight, the conversion index, keeping the livestock, the slaughtering efficiency, percent of cut pieces) it appears that none was significantly influenced by blends of vegetable oils used.

Regarding the influence of the vegetable oil blends on the distribution of ***fatty acids*** determined in cut pieces, it is as follows:

The blend between sunflower oil 0.5% and soybean oil 1.5% introduced in a total ratio of 2 % in combined fodder for broilers, unlike sunflower and soybean oil determines that in the fatty acids profile for the main pieces of interest, breast and thigh, there are large quantities of oleic (26.01g/32.36g) and linoleic acids (26.97g/28.62g), but reduced quantities of linolenic acid (1.63g/1.95g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 16.54:1, and in thigh is 14.67:1.

The blend between sunflower oil 1.5% and soybean oil 0.5% introduced in a total ratio of 2 % in combined fodder for broilers, unlike sunflower and soybean oil determines that in the fatty acids profile for the main pieces of interest, breast and thigh, there are large quantities of oleic (28.14g/32.57g) and linoleic acids (29.17g/30.06g) but reduced concentrations of linolenic acid (1.24g/1.18g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 23,52:1, and in thigh is 25,48:1.

Unlike the other blends, this one, formed of 0.5% sunflower oil + 0.5% soybean oil + 1% linseed oil, determines that in the fatty acids profile from the main pieces of interest, breast and thigh, the acids represents an uniform distribution, the quantitative differences being reduced thus: oleic acid (34.80g/34.93g), linoleic acid (27.59g/28.01g) and linolenic acid (5.03g/5.08g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 5.48:1, and in thigh is 5.51:1.

Just like the previous blend, the one with 1.5% sunflower oil+0.5% linseed oil determines the same uniform distribution of the fatty acids in the main pieces of interest, breast and thigh, the quantitative differences being also reduced: oleic acid (35.81g/33.25g), linoleic acid (25.75g/29.40g) and linolenic acid (3.52g/3.87g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 7.31:1, and in thigh is 7.62:1.

It can be seen that by using linseed oil in blends with other oils influences significantly the fatty acids profile in combined fodder for broiler carcasses.

In conclusion, we can say that from 0.5-1%, linseed oil, introduced in blends, can influence the fatty acids profile in broiler carcasses.

Experiment IV,

Regarding the ***nutritive and bioproductive indicators*** (feed consumption, body weight, the conversion index, keeping the livestock, the slaughtering efficiency, percent of cut pieces) it appears that none was significantly influenced by the refined or unrefined sunflower oil.

Regarding the influence of the fatty acids source (vegetable oils - refined or unrefined sunflower oil) on the distribution of ***fatty acids*** determined in cut pieces, it is as follows:

Refined sunflower oil introduced in a ratio of 4% determines that in the fatty acids profile for the main pieces of interest, breast and thigh, there are large quantities of oleic (24.81g/30.19g), linoleic acids (21.82g/23.17g), and linolenic acid (0.60g/0.66g), in lower quantities. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 36.36:1, and in thigh is 35.12:1.

Unrefined sunflower oil introduced in a ratio of 4 % in combined fodder for broilers determines that in the fatty acids profile from the main interest pieces, breast and thigh, there are similar quantities as those obtained for refined sunflower seed oil, i.e.: large quantities of oleic (30.11g/32.32g), linoleic (28.08g/29.08g) and linolenic acids (0.60g/0.630g). The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 48.55:1, and in thigh is 46,15:1.

The blend of refined de sunflower oil 2% and unrefined 2% introduced in a toatal ratio of 4 % in combined fodder for broilers determines that in the fatty acids profile from the main interest pieces, breast and thigh, there are relatively similar quantities oleic (26.48g/33.46g), linoleic (22.82g/23.85g) and linolenic acids (0.46g/0.72g) as is the case in the use of refined or unrefined sunflower oils. The ratio between linoleic acid (ω-6): linolenic acid (ω-3) in pectoral muscles is 49.60:1, and in thigh is 33.12:1.

We can say the type of sunflower oil (refined or unrefined) or the blend between the two does not significantly influence the fatty acids profile in broiler carcasses and can recommend sunflower oil that has a lower price.

RECOMMENDATIONS

The research done demonstrates that incorporating a vegetable oil (sunflower, soybean or linseed oil) starting with a 2% ratio in the structure of a combined fodder can influence the fatty acids profile in carcasses and some interest cut pieces (breast, thigh), which can constitute a means of nutritional intervention in order to satisfy the needs of consumers, thus contributing to obtaining foods with functional qualities.

- ***Experiment I*** Using sunflower oil as an energy source in the combined fodder for broilers can influence the fatty acids profile in carcasses and can also accentuate the unbalance of the ω-6:ω-3 ratio in human diet. Soybean oil is a source that can be used as an alternative to sunflower oil, because of its high content of linoleic acid (ω-3), in a participation ratio of 2%. A rich source of polyunsaturated fatty acids, thus also ω-3, linseed oil influences significantly the linolenic and linoleic fatty acids ratio which permits its recommendation in the structure of combined fodder for broilers in a ratio of 2%, contributing thus to obtaining functional foods from broiler carcasses.
- ***Experiment II*** The combination of different energy sources – vegetable oils 2% (sunflower oil, soybean oil and linseed oil) and CLA in a ratio of 1% has determined an accumulation of monounsaturated fatty acids, but also a decrease of the mono and polyunsaturated/saturated fatty acids ratio, starting with sunflower oil towards linseed oil. Thus, linseed oil in combination with CLA significantly influences the ratio between linoleic and linolenic acids, which permits its recommendation in the structure of combined fodder for broilers; also, it is preferable to use soybean and linseed oil in combination woth CLA, instead of sunflower oil. From 1% of CLA in the sense desired by nutritionists, it can influence the fatty acids profile, ω-6, ω-3 and ω-9 in broiler carcasses.

- ***Experiment III*** Using the blends of soybean oil (0.5%-1.5%) sunflower oil in a total ratio of 2% in combined fodder for broilers determines modifications regarding the fatty acids profile, thus the quantity of ω-6 fatty acids decreases with the participation of soybean oil.

Blends formed from sunflower oil in equal proportions (0.5%) and linseed oil (1%) have determined ω-3 fatty acids accumulations in carcasses; also the blend of sunflower oil (1.5%) linseed oil (0.5%) determines that at the level of carcasses the concentration of ω-3 fatty acids rise in the detriment of ω-6 fatty acids. We can say that using different combinations of linseed oil and in different ratios of participation (0.5%-1%) it can reduce the quantity of ω-6 fatty acids, but also the growth of ω-3 fatty acids and obtaining functional products (ω-3 fatty acids enriched carcasses).

- ***Experiment IV*** Refined, unrefined or blended sunflower oil, does not influence significantly the fatty acids profile in broiler chicken carcasses, thus the use of the two types in combined fodder for broilers, in a ratio of 4% has the same effects.