ABSTRACT

of the PhD Thesis entitled :

Researches on obtaining some functional foods by animal original using row materials feeds with favourable impact on the environment

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The doctoral thesis is structured in two parts: bibliographic study and own researches, consisting of the abstract of the thesis, content, introduction, 9 chapters containing 103 tables, 13 charts, 6 figures and 25 own pictures, and the bibliography includes 190 titles

The novelty of the thesis is given by the use of vegetable by-products, used as raw materials in farm animal feed (laying hens, broilers, fattening pigs and dairy cows) to enrich foodstuffs with polyunsaturated fatty acids essential for human health. Another **novelty** is the use of the **Analytical Hierarchy Process (AHP**) to choose the best chicken feed dietes. The AHP method is based on experimental results such as raw material cost, final food quality, nutrient content, diets price, and the impact of using these recipes with by-products on the environment

PART I, BIBLIOGRAPHIC STUDY, comprises two chapters, structured as follows:

CHAPTER I - FUNCTIONAL FOODS, in which are presented the benefits, the way of obtaining, the importance and what are the main functional foods on the international market but also their marketing.

CHAPTER II - THE USE OF VEGETABLE BY-PRODUCTS IN THE ANIMALS FEEDS WITH THE PURPOSE TO OBTAIN FUNCTIONAL FOOD, describing aspects related to the importance of the use of the by-products in animal nutrition, as well as the description of the by-products used in the researches undertaken in the framework of the functional nutrient intake .

PART II, OWN RESEARCH, consists of seven chapters detailing the purpose of the doctoral thesis, the materials and methods used to achieve the objectives, the results obtained and the discussions revealed by the researches carried out, the general conclusions, the recommendations and the prospects for the use of these by-products, with valuable potential in animal feed.

CHAPTER III - PURPOSE AND OBJECTIVES OF THE RESEARCH ACTIVITIES. ***Within this PhD thesis, I have studied some vegetable by-products as raw materials, more or less known and used in animal feed, to track their influence on bioproductive performance, to determine***

the nutritional characteristics of foods (egg, meat , milk), the animal health status and their environmental impact.

CHAPTER IV - MATERIALS AND METHODS, describing the feed materials used in the diets of the experiments carried out, the biological material used and the nutritional requirements, the way of organizing and developing the experiments, the chemical composition of the diets and their structure, the quantitative and qualitative parameters pursued, chemical and microbiological methods used to achieve the proposed objectives and the novelty of the thesis, the hierarchy methodology (AHP) of the feed formulations used.

CHAPTER V - RESULTS AND DISCUSSION, in which are presented the determinations regarding the nutritional value of the by-products studied.

CHAPTER VI - RESULTS OBTAINED IN LAYING HENS EXPERIMENT, where **EXPERIMENT 1** is presented - which aimed at obtaining polyunsaturated fatty acids enriched eggs and providing antioxidant capacity in fodder and egg by using cakes / wastes from food industry. The experiment was carried out on 120 laying hens from the TETRA SL hybrid, housed in digestibility cages to allow digestion studies to be carried out in four lots: the control group (M), the experimental group 1 (E1), the experimental group 2 (E2), Experimental Lot 3 (E3), which had the same basic structure of the combined feed, the difference being given by the introduction of the by-products tested: rapeseed and grapeseed meals (E1), sea buckthorn and flax meals (E2), pumpkin meal (E3).

CHAPTER VII - RESULTS OBTAINED ON THE BROILERS EXPERIMENT where in **EXPERIMENT 2**, I have used the same vegetable by-products as in the laying hens experiment, for the purpose of obtaining meat as a functional food enriched in polyunsaturated omega fatty acids 3 and increased antioxidant capacity in meat. The experiment was carried out on a flock of 100 ROSS 308 broiler chickens distributed in four groups (M, E1, E2 and E3), housed in an experimental controlled microclimate hall that offers the possibility of developing studies on digestibility of nutrient digestion.

CHAPTER VIII - TESTING THE VEGETABLE BY-PRODUCTS IN A FARM LEVEL EXPERIMENT ON FATTENING PIGLETS, this chapter includes **EXPERIMENT 3,** which aimed at assessing the nutritional value of pork by using flax and grape grape. The experiment was run for 6 weeks on 12 pigs fattened from the TOPIGS hybrid, divided into two groups The difference between the experimental group (E) and the control group (M) was given by the by-products tested: flax and grape seed. The initial body weight of the animals tested was 66.42 kg ± 10.27 (M) and 66.25 kg ± 9.88 (E), respectively.

CHAPTER IX - RESULTS OBTAINED FROM THE EXPERIMENT DEVELOPED ON DAIRY COWS, the chapter contains the results of **EXPERIMENT 4**, run in IBNA-Baloteşti Experimental

Biobase, over an experimental period of 30 days, using a number of 15 Holstein dairy cows , divided into 3 batches. As with previous experiments, in the new feed formulations we used vegetable byproducts to enrich the quality of milk in omega 3 fatty acids. Thus, experimental networks included in the structure 12% flax meal (E1) and 12% flax meal and 16.35% barley rootlets, diets being balanced iso-protein and isocaloric.

GENERAL CONCLUSIONS

There have been studied 4 vegetal sub-products from oils' industry (rape, grape, flax, buckthorn and pumpkin meals) and the barley rootlets; all these sub-products have been taken into consideration in elaborating new feed recipes for laying hens, broilers, fattening and dairy cows.

The rapeseed meal has been considered as rich- protein feed resource (33.15%) and linoleic acid (35.03g/100 total fat acids) which is an omega 6 polyunsaturated acid. The polyphenolic concentration from grape seed meal, through its phenols concentration (100.082 mg trolox /probe gram) and its antioxidant capability (493.074 mMTroloc/g) has the advantage of natural antioxidant.

The flax meal is the most important vegetal resource of alpha linolenic acid (42.93g/ 100 fat acids). The buckthorn meal, through its phenols concentration (12.012 mg equivalent rutin/ g of probe) and its antioxidant capacity (56.784 mMTrolox/g) is used as well as natural antioxidant.

For the first digestibility experiment, which took place over 5 weeks on 160 Tetra SL laying hens (56 weeks), divided in 4 groups (M, E1, E2,E3), were elaborated 3 new structures of feed recipes and whose effect have been compared with those of a conventional one (i.e. M).

The basal structure of the combined feeds has been the same for all 4 groups, with the only difference between the experimental group and the conventional one being the different ratio of included vegetal by-products. In E1 group recipe, compared to M recipe, were added rapeseed (rich in omega 6 polyunsaturated acids) and grape seed meal from grapes' seeds (natural antioxidant for preventing the oxidation of the fat polyunsaturated acids brought by rapeseed).

The highest concentration of α linolenic acid (13,82 g/100g total fat acids) has been identified in the NCE2 feeds, which contained the flax meal. The highest antioxidant capacity (14.41 mM Trolox/g) was recorded in NC E1 (with rape meal and grapes meal). The Kreiss reaction showed that rancidity process appeared for all fodders in 28 days after production stage.

The ratios of heavy metals in the combined fodders' probes have been considerably lower than the admitted maximums, while the Escherichia Coli and Salmonella determinations have shown that the analysed combined fodders do not represent any risk for the birds' health.

As far as the production parameters are concerned, among the experimental lots, the best results have been recorded in the laying hens group which had included in feeds a ratio of 9.5% of rapeseed and 3% off grape seed meal(E1). At the end of the experiment, the eggs coming from lot

E2 (flax meal and buckthorn meal) have had the highest concentration (P≤0.05) of fat omega 3 acids, i.e. 8 times higher than in the other three fodders.

The second experiment took place over 42 days and on a number of 120 chickens Ross 308, uniformly divided in 4 experimental groups (M, E1, E2 and E3), 30 chickens per group. For 10 days, during starter period, all the chickens have been fed with the conventional diets. For the experimental period (10-42 days), the feed recipes were structured in phases (growth, respectively finisher).

Even though the combined fodders from lots E2 and E3 have had high concentrations of fat poly unsaturated acids, the indicators of fat degradation from all the 3 experimental feeds, which have been determined in 14 days after production, showed similar values with the ones coming the testimonial fodder.

There have not been recorded significant differences (P≤0.05) for the production parameters, with the exception of the body weight after 42 days which was significantly higher (P≤0.05) for group M, compared to experimental groups E2 and E3. There were not recorded significant differences (P≤0.05) between groups as far as the average weight of the carcass (g) is concerned, the only exception being made by group E2 which recorded a drop of 9.3% compared to the weight of the carcass recorded for lot M.

Concerning the biochemical parameters, in experiments II and III, was proved that utilizing the two by-products, rich in unsaturated fats, the percentage of n-3 polyunsaturated fats increases in the blood tissue of the pigs and it drops dramatically the concentration of plasmatic triglycerides.

The concentration of omega 3 polyunsaturated fatty acids (PUFA omega 3), which are fundamental for the human health in the chicken breast samples, have been higher in the samples gathered from the experimental groups. Therefore, the α-linolenic acid had, in the breast coming from group M, a concentration with 68.80%, 68.52%, and 36.32% lower than the one coming from the breast samples from groups E1, E2 and E3 respectively.

The determinations from the manure showed that the analysed concentration domains for heavy metals are situated significantly lower under the maximum admitted value from regulation 344/2004. Consequently, the chicken manure do not pose any threat on the environment. By comparing with lot M, it has been observed that for the manure coming from experimental lots it was recorded a decrease of the Pb indicator: 0,84 mg/kg DM in E2, 0,87 mg/kg DM in E1 and 0,9 mg/kg DM in E3, versus 2,66 mg/kg DM in M.

It has been used the AHP evaluation methodology in order to hierarchize the tested feed receipts and to choose the best recipe based on the quality/cost/environmental impact performances. E1 recipe was granted first place (with rapeseed meal and grapeseed meal).

The third experiment took place in IBNA Biobase, for a period of 6 weeks, on 12 pigs, under fattening process from TOPPIGS hybrid and divided in 2 lots. The difference between the experimental lot and the testimonial lot was given by incorporating the flax meal and the grapes meal. As far as the fat acids are concerned, the experimental recipe contains 14.02g of α linolenic acid/100g total fat acids, whereas the testimonial lot contained only 2.73g of α linolenic acid/100g total fat acids

The increase by 5.13 times of the linolenic acid (omega 3) is due to the fact the flax meal was included in a ratio of 7.5%. The fat degradation indictors were situated within the maximum admitted limits for the 2 combined fodders, in the case of both periods of preservation: 14 days and 28 day respectively.

The heavy metals concentrations in the probes coming from both fodders were significantly lower than the admitted concentration. Therefore, it can be considered that the two fodders do not have negative impact on the environment.

During the analysis of the milk which was collecting during the evening, the highest level of proteins was determined in the probes coming from lot E2 (21,64%) versus the ones form lot M (19.85%). Both in the morning and evening milk collections, the percentage of milk's fat from lot M was higher than for lots E1 and E2.

The concentration of α linolenic acid in the probes coming from the milk which was collected in the morning, at the end of group E1 experiment had a concentration (0.53 g/100g total fat acids) significantly ($P \leq 0.05$) higher than for group M (0.24 g/100g total fat acids). Moreover, the concentration from lot E2 (0.49 g/100 g total fat acids) was significantly ($P \leq 0.05$) higher than for M group . Same significant differences ($P \leq 0.05$) were observed also for the milk which was collected in the evening.

RECOMMANDATIONS:

It is absolutely necessary to discover new modern solutions in order to comply with the more na more complex requirements that are coming from nowadays society which is in a continuous search of safe, innovative, qualitative and diverse functional food. The nutrition is perceived as a relatively simple and safe way in obtaining functional food, even in the circumstances of suing sub-products.

Furthermore, the research must continue, in order to highlight new vegetal sub-products, with high nutritive values, beneficial for human and animal health and should not have a negative impact over the surrounding environment.

PERSPECTIVES:

In the current context, there still remains a wide research field in the present thesis' topic, such as: the percentage of included by-products, synergies, the complementarity among different sub-products, other than the ones already researched and whose use in the animals' food could lead to obtaining more beneficial functional foods .

Key words:

by-products, functional foods, omega 3 fatty acids, food quality, health