ABSTRACT

The constantly increasing rate of the world population, the extension of the industry facilities and the urban centres development leaded to an increase of energy, raw matters and food requirements, resources although limited by our planet geographical and environmental limits.

Starting from these conditions, granting the population access to food supply has become a first line topic. Meanwhile, the animal products are still considered as the most important protein source for human nutrition.

The aviculture field gains, more and more, its important place among the competition into the achievement of this goal, providing to the people enough quantities of some products having high protein levels, such as meat and eggs.

The animal products quality continuously improved, due to the concurrency of the marked or to the customers' requirements.

Rearing chicken broilers consisted into an activity with permanent character, this animal science field providing almost 86 % of the worldwide meat yield.

Meat producers and especially those producing poultry meat must focus on the achievement of both high quantitative and qualitative yields, as good as trying to decrease the production expenses, respecting meantime the principle stating: "Safe feed for animals – Safe food for people - Health". The nutritionists play an important role into the achievement of these purpose, they should find new ways to produce high quality animal products at costs affordable for all categories of customers.

The usage of bio-growth promoters has been functioned as a very useful way to achieve better performances in broilers production but the actual trends impose to eliminate the artificial growth factors, mainly due to their persistence within the final products and to their adverse effects onto the customers' health. These promoters are now replaced by natural products having similar effects.

The trials during last years tried to identify such additives to be able to maintain a good level of animals' health, to achieve high yields, to better valorise the nutritional facts of the feed, without inducing antimicrobial resistance at the human consumers.

As a consequence to the removal of the antibiotics from the approved bio-growth promoters list in Europe and other regions, a new goal to find strategies basing on natural

sources of promoters issued within the nutritional sciences field. High accents have been applied to the usage of the medicinal, aromatic and spicy herbs, knowing the synergic actions between their compounds and, during the last years, the usage of the essential oils issued from several plants being mostly practiced.

The advanced system used in medicinal herbs processing and the scientific testing methods allow the election of the active substances within plants and the possibility to *"in vitro''* or *''in vivo"* establish their beneficial potential, the minimal levels of inclusions, and the usage form, in order to utilise them as alternatives to antibiotics in animal husbandry.

Over than 10,000 herbs species are known with capabilities to be used as natural remedies within prevention or treatment of several diseases in both humans and animal, but over 90% of their active compounds still need to be chemically identified and to better establish which are their metabolic involvement degree as well as their toxicity degree.

Hippocrates said „Let the food to be the first medicine". This aphorism is applicable today more than other time, knowing the worldwide orientation in seeking as much natural resources to be used as bio-growth promoters or as medicines in animal science.

Worldwide researches, concerning several botanical additives utilisation in chicken broiler feeding showed that good zootechnical and economical performances could be achieved, while the consumers could be safe that the products will not affect their health.

Considering the reasons stated above, within the researches undertaken to fulfil the PhD degree with the dissertation called *"Researches concerning the utilisation of some natural bio-growth promoters as an alternative to the usage of the antibiotics and of other synthesis-base growth promoters in chicken broilers feeding"*, it has been studied the biostimulative effect of several botanical additives, and some conclusions and recommendations for using these products as antibiotics replaces have been issued.

The dissertation comprises two sections, respectively a *bibliographical review* and the *original researches' results*.

The *bibliographical review* includes three chapters which emphasis on several aspects concerning broiler husbandry, broiler nutrition and feeding peculiarities, feed additives and especially botanical additives usage in broilers feeding.

The *original researches* section counts six chapters including experimental design, description of aromatic, spicy and medicinal herbs and the results and discussions issued from the experiments.

The own researches have been structured by four experiments, considering the botanical additive type used in broilers feeding as the main experimental differentiation criterion. The purpose of each experiment was to establish if the used botanical additives could induce beneficial effects toward chickens growing and development, in order to achieve economical revenue and finally, to use them as antibiotics replacement.

Ross 308 broilers, both genders, were used as biological material.

Complete type mixed fodder has been used within the four experiments, according to the three feeding stages: starter, grower, grower+finisher. The recipes' features were characterised by this levels: protein content of 22 % during starter period, 20 % during grower period and 18 % during grower-finisher period; the corresponding energetic levels being of 3005 kcal EM, 3100 kcal EM, respectively of 3153 kcal EM /kg mixed fodder.

A series of medicinal and spicy herbs were used as additives, given either as powder into the fodder, singular or mixed, either as aqueous, oily extracts or essential oil.

The studied parameter for all the experiments were: live weight dynamics, weight gain dynamics, feed intake and its conversion efficiency, water intake, flock looses and their casualties, economical efficiency as influenced by the usage of the studied medicinal and aromatic herbs.

Other parameters, such as: quantitative and qualitative meat yield, carcasses' weight and quality classification, slaughtering efficiency, weight of the main trenched parts, weight of the main internal organs, physical, chemical and sensorial features of the meat have been supplementary assessed during 2^{nd}, 3^{rd} and 4^{th} experiments.

Within the *1^{st} experiment,* the garden thyme (*Satureja hortensis)*, presented as aqueous extract 0.7% or as powder 0.5% included into the feed.

Better production and economical results were recorded by the experimental groups, as compared to the witness one, when garden thyme was used in broilers feeding.

Some differences occurred between experimental group as consequences of the thyme presentation forms and proportions.

Best results were achieved by the chickens belonging to the group which received aqueous extract obtained from the aerial parts or the garden thyme, followed by the groups which received 0.7% and 0.5% thyme powder added in feed. Thus, compared to witness group, the values obtained by the additives added treatments were 6 – 9.95 % better, for the average live weight prior to slaughtering moment and 7.3 - 10 % better for feed conversion

ratio (decreased values), as well as the best economical efficiency, consequently to the usage of the thyme aqueous extract.

During the *2nd experiment*, different proportions of aromatic and spicy herbs were used as additives: 0.05 % hot pepper powder (*Capsicum annuum),* 0.7 % garden thyme *(Satureja hortensis)* and 0.5 % dill powder *(Anethum graveolen*s), the results being compared to those obtained with a negative control group (no additive in feed).

The effects generated by the additives used within the 2nd experiment were beneficial onto the broiler growing performances, proving real biostimulative features. Thus, compared to control group (no additive) better results were achieved for several characters: +2.3…+4.2 % for live weight prior to slaughtering moment, +2,1…+2,3 % for the average weight of the carcasses as well as for the main carcass trenched parts: +1.68…+1.95 % for the breast, +1.24…+1.95 % for the thighs and drumsticks. Better performance was also observed for the weight of the main internal organs: +3.01…+4.87 % for the liver, +1.70…+4.47 % for the gizzard. The meat from the broilers within experimental groups presented best assessment for the sensorial features, slightly improvement in protein content and even reduced values for fats. The feed conversion ratio was also reduced (-4.2…-9.5 %) in groups receiving additives as compared to the negative treatment.

The chickens which received garden thyme in feed gave the best performance, showing that the 0.7 % proportion of powder could be the most reliable inclusion rate to be used in broilers feeding. Thus, the cost per kg of additive could reach, in conditions of efficacy the cost of maximum14.99 kg of feed. Using the European Efficiency Factor to analyse the economical performance, we could state that the botanical additives used in chicken feeding assure 23-33% better economical results in positive treatments, as compared to the control one.

During the *3rd experiment*, a series of aromatic and spicy herbs were used as botanical additives: garden thyme (*Satureja hortensis),* hot pepper (*Capsicum annuum*) and dill (*Anethum graveolen*s). A prebiotic product (Bio-Add) and an antibiotic (avylamicin) were also used.

Several mixtures of plant powders were established, in order to add them to broilers feed: a mixture of 0.9 % thyme and 0.1 % hot pepper; a mixture of 0.7 % thyme and 0.3 % dill, a mixture of 0.7 % thyme and 0.3 % prebiotic and another mixture of 0.6 % thyme, 0.3 % dill and 0.1 % hot pepper. The obtained results were compared to those achieved by a group which received only regular feed, without additives.

When the average weight obtained after the 42 experimental days was assessed, the best results, as compared to control group, were found in the antibiotic group, followed slightly by the chickens in the groups received 0.6 % thyme, 0.3 % dill and 0.1 % hot pepper.

Best values for the feed conversion ratio were observed at the groups with botanical additives included in feed, being 1.64 – 4.9 % less than those calculated for the control group. Among the experimental groups, best value for the feed conversion was achieved by the chickens which received a feed supplementation with a mixture made of 0.6 % thyme, 0.3 % dill and 0.1 % hot pepper.

The results obtained for the other studied characters were found better for the groups which received additives, as compared to the witness group: +1…+8.4 % for the carcasses weight; slaughtering efficiency values included within 70.85 – 71.29 % interval; +2.12…+9.92 % for breast weight and +2.1…+9.9 % breast fillet participation within whole breast; +2…+9,8 % for thighs and drumsticks weight and +1.9…+9.5 % for the rest of the carcass; better values were observed also for the main internal organs weight: +2.1…+10 % for the liver, +1.7…+17.7 % for the gizzard, +9.8…+27.7 % for the heart.

Best sensorial features were assessed for the samples issued from the chickens which received several types of mixtures: 0.9 % thyme + 0.1 % hot peppers, 0.7 % thyme + 0.3 % dill and 0.6 % thyme+0.3 % dill+0.1 % hot pepper. Concerning the chemical composition, it was observed that the meat produced by the chickens which received botanical additives was slightly richer in proteins and poorer in fats, as compared to the control group.

When the economical efficiency of additives usage during the 3rd experiment was analysed, the mixture of 0.6 % garden thyme, 0.3 % dill and 0.1 % hot pepper proved to be the most efficient to use in broilers feeding. Thus, one kg of botanical mixture costs a maximum value of 5.17 kg feed.

Considering the European Efficiency Factor, it could be stated that the groups of broilers which received mixtures of botanical additives gave 2 - 19 % higher values than that calculated for the control group.

The better results achieved by the chickens which received additives in feed prove the biostimulative effect of the used additives. Best results were found in the group which received a mixture of 0.6 % thyme, 0.3 % dill and 0.1 % hot pepper.

The *4th experiment* included researches which observed the effects of other botanical additives, different as inclusion proportions and as presentation form: 0.5 % rosemary powder (*Rozmarinus officinalis*), 0.5 % oregano powder (*Origanum vulgare*), 0.1 % oil extract of

salvia (*Salvia officinalis*), 0.1 % oil extract of culture thyme (*Thymus vulgaris*) and 0.05 % rosemary essential oil. The results achieved by the chickens which received additives supplementation were compared to those obtained by the control group, whom feed was supplemented with an antibiotic (avylamicin).

There were not recorded significant differences between the results of the control group and those of the botanical additives supplemented ones, concerning the body weight at 42 days, carcasses weight, the weight of the main trenched parts and of the internal organs. Thus, even if the chickens fed with antibiotics gave the highest weights at the end of the experiment, the values achieved by the broilers fed with botanical additives were not significant different by those obtained by the control group. Moreover, the feed intake was 1.13 – 1.69 % lower at the experimental groups. Par consequence, the botanical additives could be considered as an eligible alternative to the antibiotics usage as growth promoters.

The sensorial assessments showed better results for the chickens which received oil thyme extract, rosemary powder and oil salvia extract.

The most efficient proved to be the 0.1% oily culture thyme extract but the other used additives could also be noticed, mainly because the feed conversion rate was reduced or almost similarly to those obtained by the control group (antibiotics added) situation that could be successfully used by broiler breeders. Analysing the economical results through the European Efficiency Factor values, it's obviously that the best results were achieved by the broilers groups which received 0.5 % rosemary powder and 0.1 % oil thyme extract – values of the EEF of 107.17.

It could be stated that the botanical feed additives studied in all experiments leaded to better results in chicken broilers production, as compared to control group (no additives); thus, the live weight values were 1.8 -9.95 % higher, the feed intake values were 1.13 - 10 % reduced and feed conversion ratio report was also better while the water intake was 2 -18.9 % reduced. Poultry carcasses were 1 – 8.4 % bigger and the slaughtering efficiency reached values within 69.84 % - 71.29 % interval, while breast participation percentage in whole carcass was 1.24 – 9.92 % improved, of thighs and drumstick was also found 2 – 9.92 % better; internal organs weight also increased: +2,1…+10 % for the liver, +1.07…+17.7 % for the gizzard, +0.35…+27 % for the heart. The used botanical additives stimulated the development of the internal organs, especially of those belonging to the digestive apparatus; botanical additives could well stimulate the digestive secretions, leading to a better absorption and valorisation of feed compounds.

No significant results were observed when the performances of the chickens receiving botanical additives were compared to those achieved by another control group, which received antibiotics as growth promoters.

Very good results were observed regarding the chickens liveability, considering that no prophylactic treatment was applied.

Concerning the efficiency, the best results were given by several additives: aqueous extract of garden thyme (1st exp.); powder of garden thyme, 0.7 % included in feed (2nd exp.); powder mixture of 0.6 % garden thyme, 0.3 % dill and 0.1 % red pepper (3rd exp.); 0.1 % oil extract of cultivated thyme and 0.5 % powder of rosemary (4th exp.).

We consider all positive effects observed in chickens receiving feed supplemented with different kinds and proportions of botanical additives were based onto the action of the bioactive compounds within the medicinal aromatic and spicy herbs we utilised.

All those previously mentioned aspects could be considered in order to advice the botanical additives utilisation into the chicken broilers feeding, especially as antibiotics replace. They also open new ways in experimental research applied to the issuance and certification of several natural products to be used as bio-growth promoters in chicken broilers.

The own researches were among the first one takes in Romania, mainly concerning the utilisation of some products issued from medicinal plants and/or spicy herbs, the new aspects dealing with those used vegetal species, giving them distinguished original characteristics.

The paper includes 342 pages, comprising 114 tables, 16 figures and 7 charts; 335 references titles have been examined.