ABSTRACT

The thesis consists of 239 pages divided into two parts and in order to be written, a number of 311 bibliographical titles were used as source of information and documentation.

The first part, which contains 51 pages, reflects the state of knowledge concerning the metabolic profile in association with the reproduction activity for dairy cows based on bibliographical references. It is structured into 5 chapters and 11 subchapters where, according to the data from the reference literature, the state of the knowledge on the local and international level is described, mentioning:

- The elements that consist the basis for the establishment of a surveillance program for the metabolic health in cow farms, which are necessary for detecting the metabolic disorder and their causes, meaning the revelation of disturbance in what the animal nutrition and the use of fodder resources is concerned, and also some toxic influences, especially upon the parenchymal organs;
- The indicated set of analyses to be done on cattle for the surveillance and the evaluation of the state of metabolic health;
- The establishing of the right moment for the carrying out of the metabolic profile in dairy cow farms.
- The features of the metabolic profile in dairy cows and certain physiologic limits (maximum and minimum) of some constituents of the haematological, protean, energetic, mineral and vitamin profiles, and also the implications of the abnormal indicators in disturbing the state of the metabolic and reproductive health **(cap. I).**
- The description of the normal evolution for the gestation and the puerperal period on cows; **(cap. II and III)**.
- The implications of the nutritional-metabolic disorders in the pathology of gestation and puerperal period **(cap. IV).**
- The relations between the negative energetic balance and the reproduction performances on dairy cows **(cap. V)**.

The second part, consisted of 146 pages, contains the result of individual researches in the correlations between some metabolic profile parameters and the cow breeding. It is structured in 9 chapters and it presents 64 illustrations and 43 charts.

In the first chapter of the second part, the purpose and the objectives of the PhD thesis are presented **(cap. VI).** The following chapters show a detailed presentation of the objectives, each of them containing the material and the applied methods, the results, discussions and the conclusions.

The choosing of the research subject was sustained by the following aspects:

- Along with the appearance of the modern systems of development and exploitation, of the high standards for the production of milk, the present race of cattle which have reached a great level of economic efficiency through the selection of genes, whose features have arrived to the extreme physiologic limits, present a big liability of the organic and homeostatic balance in the smallest trouble of the environment factors.
- The problem of the metabolic disorders caused by nutritional imbalances must be regarded with great attention because in nutritional pathology, the clinical manifestations are not present and their appearance represents an important sign of some significant diseases.
- In the clinical stage of a metabolic affection, its treatment is difficult and expensive and many times it lacks success.
- That is why it is necessary to have a profound knowledge of the exploitation and maintenance requirements in diary cows so that every modification of the metabolic balance to be noticed in the stage of biochemical injury.
- This being said, the beginning of lactation in cows with great milk production must be interpreted as an express state of stress because the organism is adapting to the needs that appear due to the increased activity of the mammary gland
- For this cause, the resources from the deposits of the body such as fat are being used for the metabolic necessities, and the negative energetic balance usually appears.
- Given the current discoveries, it is still undecided if the abundant food and the gaining in weight of cows are the only important etiologic factors in the pathogenesis of these disorders or it involves other factors responsible for the regularization of the energy flux in the peripartal period.
- The negative energetic balance caused by the energetic decrease, represents one of the most important factors in interfering with the normal evolution of the sexual process in cows at the beginning of the lactation period.

The metabolic profile represents a complex diagnostically system which consists of two types of investigations:

- *Biochemical*, on blood, serum, plasma, urine, milk, rumenal liquid or other biological liquids.
- *Haematological*, by running some quantitative exams (the number of erythrocytes, Ht, Hb, VEM, HEM, CHEM, the number of leucocytes WBC) and qualitative exams

(citomorfological, leukocyte formula) on the peripheral blood, as well as on the marrow bone spine.

The determination of some biochemical parameters from serum and milk and hematologic parameters from blood was possible due to these researches.

We emphasize the fact that the investigations that led to the underlining of the correlation between some metabolic profile parameters and the breeding in cows implied:

- The analysis of the fodder and the ratio of the food;
- The metabolic profile examinations biochemical and haematologic;
- The examination of the cows for breeding, the examination of the gynecologic sheets(the gynecologic investigation)
- The use of statistic tests for pointing out the significant differences among some metabolic profile parameters and the association between them and the breeding performance.

Taking into consideration the soil-plant-animal circuit, some authors believe that the investigations must have as leading point the soil analysis. This isn't concluding because the elements that are assimilated by the plants cannot be determined quantitatively.

The determination of the composition of the silage is more appropriate because it indicates a real and more complete data for the given sample, with the condition that it presents exactly the quantity of silage it has both for the floristic composition, as well as for the strain-leaves rapport.

Only the determination of the chemical composition of the silage introduced in the meal indicate correct information about the nutritive level and a comparison with the one that is recommended by the feeding standards can be possible, enabling the diagnose of *primary deficiencies.*

The *secondary deficiencies,* because of the modifications generated by digestibility, absorption and elimination of the nutritive elements, cannot be detected but on the animal itself, by doing the so-called *metabolic profile*.

In the case of dairy cows, the insemination and the installation of gestation take place when the lactation is at its peak, except for the heifer. This is why the cows with a great production of milk present a decline in the breeding function.

The many investigations that took place showed inversely proportionate relations between nutrition and lactation on one hand and reproduction on the other hand, taking into consideration the argument for the priority in division of the nutritive substances.

So, it was noticed that the reproductive process of cows can beneficiate of the necessary nutritive substances only after the production of milk and the corporal needs have been satisfied.

Taking into account the obligation of maintaining a reproductive productive cycle of approximately 365 days, the way in which the nutrition influences the breeding process becomes essential.

In the researches that were done in the three dairy cows farms situated in the north-east of Romania it was observed that the silage ratios presented a satisfactory contribution of the nutritive principles, but with a low energetic density, no matter of the breeding and exploitation system.

The presence of the deficit of rapidly absorbed energy in the period of advanced gestation and of high level of lactation coincides with the modification of the biochemical parameters and the fertility of these females.

In the case of farm I , the analysis of the biochemical profile showed that the majority of the compounds, except for the total protein and serum albumins, present a decrease in value during an advanced gestation compared with the peak of lactation, keeping them in physiological limits.

The presence of 0,90 UFL/Kg SU in the ratio of the first reproductive-productive year evolved simultaneously with the decrease of the serum glucose value from 56,1± 4 mg/dl in the peak of lactation to 45,2 ± 7 mg/dl during the late gestation, values that are close to the minimum physiological limit.

In the second year an energy supplement with Ca was administrated, containing vegetal fat with a high degree of absorption and digestibility (85% UFL) and minerals of Ca for stabilization and the second product was represented by a protein supplement. An increase was noticed to 0,95 UFL/Kg SU, of glucose to 73 ± 8,09 mg/dl in the lactation peak and 59 ± 4,1 mg/dl during the advanced gestation and of the level of cholesterol of 205,36 ± 39,67 mg/dl in the highest level of gestation and of 132,25 ±29, 41 mg/dl during the advanced gestation. The increased values of glucose and cholesterol in the metabolic profile in the highest lactation level of the 6 cows from the set of observation coincided with the service period of 46 to 87 days, while the other cows with a low level of glucose had a service period greater than 90 days.

Analyzing the simple correlation coefficient ”r” it can be observed that it exists a moderate correlation in the negative sense between the levels of serum glucose and the value evolution of the service period(the increased values of the serum glucose evolved simultaneously with the decreased values of the service period).

After analyzing the haematological parameters along the two productive-reproductive years during the peak of lactation and the late gestation, it was observed that these do not suffer major transformations, being situated in the physiological limits.

In farm II the fodder ratios presented a satisfactory contribution of nutritive principles having though a decreased energetic density, under the minimum accepted, this being of 0,79 UFL/Kg SU in the case of the summer ratio and of 0,91 UFL/Kg SU in that of winter.

The fodder ratios disequilibrium coincided with the observation of some increased values of calving interval and of service period especially in the case of cows on their first, second and third lactation, periods when the productive solicitations are intense.

The existence of some volume ratios with decreased energetic density coincided with the observation of decreased values of serum glucose (48 mg/dl), triglyceridemia (13,05 g/l) and increased values of ALT (60,51 Ui/l), AST (196,33 Ui/l).

After analyzing the metabolic profile in correlation with the evolution of the service period and the calving interval from farm II it was observed the existence of a completely satisfactory energy-protein contribution of fodder ratios, but with a low energetic density, which determines the influence upon the hepatic functionality with direct implication in the reproduction function.

The determination of the haematological profile did not result in the observation of the differences of the environment on the physiological limits.

The evaluation of the corporal condition of dairy cows represents one of the most important indicators in the surveillance of the energetic status, especially in the peripartal period when the most expressive changes in the energetic metabolism appear.

The BCS evaluation (body condition score) resulted in the observation that beside the females which suffered no loss in the corporal condition, more than a third suffered minor losses that we appreciate as being smaller than 0,5 points and a small number suffered important losses(> 0,5 points) on a scale from 1 to 5.

The cows that presented a low average of the body condition score (BCS) from 6 to 4 weeks ante partum did not suffer losses of the BCS in this interval compared to the cows with the best BCS which suffered losses bigger than 0,5 points. In the case of the cows with a light loss in BCS ante partum (<0,5), the average of post partum BCS had the tendency of maintaining the high values compared to the other groups of cows.

The cows with a low score of body condition but also the ones with significant losses of BCS (>0,5) presented a raised incidence of placental retention, endometritis and dystocia compared to the cows with an increased score of body condition.

In what the ovarian cystitis is concerned, the greatest incidence was recorded to the females with important losses of points in their body condition.

After the haematological profile analysis in cows with pathologic cyclicity, superior values statistically significant of the numbers of leucocytes and erythrocytes compared with the cows with normal cyclicity in their highest level of lactation and advanced gestation were observed. The rest of the determined haematological parameters recorded inferior concentrations, significant statistic in cattle with pathological cyclicity compared to those with normal cyclicity.

In the case of the biochemical profile evolution in cows with pathological cyclicity, values superior to the physiological limits in ALT were observed. Still, they were reduced in serum glucose, total proteins and cholesterol level compared to the cows with normal cyclicity, giving birth to significant statistic differences.

The metabolic profile in farm II is compatible with a satisfactory contribution of nutritive principles but with a decreased energetic density, which determines the perturbation of the hepatic functionality with negative consequences on the breeding function.

In farm - III – the following were observed:

The existence of a maintenance and exploitation management based on the daily observation of the reproduction and feeding activity determined the achievement of the greatest productive and reproductive performances.

The fodder ratios administrated based on production categories (25, 33, 42 kg of milk per day) present a nutritive principles contribution superior to the optimum level. However as in the case of the other two farms it can be observed that these ratios present a reduced contribution of UFL/Kg SU, possibly due to the productive overworking which cannot be energetically covered through ratio.

The distribution analysis of the calving interval and the service period comprises approximately 40% of the females with normal values, remaining for the rest of the females to present superior values. The highest values of these two indicators of reproduction were observed once with the evolution of the second productive-reproductive year when productions of 9000 l of milk per day compared to 7000l in the first year were registered.

We could observe reduced levels of serum amylase (25,15 ± 6,19 Ui/l compared to 41,37 ± 2,17 Ui/l) and increased levels of hepatic enzymes (144,81 ± 50,5 Ui/l compared to 92,32 ± 16,6 Ui/l in the case of ALT and of 130,72 ± 78,02 Ui/l compared to 158,22 ± 42,78 Ui/l in the case of AST) in the first group of 42 l milk per day compared to group number 2 with 33 l of milk a day.

Also we could observe decreased values of glucose (47,81 ± 8,9 mg/dl group1 and 57,22 ± 4,62 mg/dl group 2) and serum cholesterol (178,51 ± 31,21 mg/dl group 1 and 255,65 ± 54,47 mg/dl group 2) and raised serum urea (46,58 ± 8,18 mg/dl group 1 and 38,12 ± 4,3 mg/dl group 2), complete serum proteins (8,52 ± 0,55 g/dl group 1 and 8,37 ± 0,29 g/dl group 2) through hiperalbuminemia (3,97 ± 0,26 g/dl group 1 and 4,05 ± 0,25 g/dl group 2).

In conclusion, the increase of S.P. and C.I. values in the second productive-reproductive year can be a consequence of the energetic stress caused primarily to the increased production of milk associated to the exploitation technology which assumes the leading of cows from maternity into the cattle number 3 of production where a ratio for a production of maximum 25 l of milk a day is administrated.

The effect of these two deficiencies had as result mobilizations of lipids from the corporal resources, noticeable through the increasing medium values of the hepatic enzymes, the reduction of medium values of the serum amylase the reduction of the serum glucose, hiperproteinemia through hiperalbuminemia.

The effect of these biochemical perturbations are based on the improper hepato-pancreatic functionalities, which through the means of the insulin and the IGF-I (the insulin growing factor I) adjusts for the dairy cows the production activity which is sometimes independent to the FSH/LH concentrations in blood or determine the reduction of the hypothalamus secretion of Gn-RH.

Beside the massive mobilization of lipids, the protein catabolism which manifests through the deamination of proteins and detoxification can lead to systemic concentrations raised by the urea. Given this fact, the detectable raised values of urea can have a toxic effect on the quality and the survival of the oocytes. Nevertheless, it is known the fact that high concentrations of urea associated with harmful effects on fertility are mainly due to the rich protein contribution of fodder ratios.

After completing the haematological profile as a part of the metabolic profile, no variations of the environment were recorded in the case of the two cattle compared to the physiological values.

The farm III required a protocol for the increase of the energetic density of ratios by introducing an energetic insulinogenic agent (Propylene glycol – PG), observing the following:

The serum amylase recorded an increasing evolution after giving birth toward normal values of 70 days post partum, superior to group E (supplemented with PG) compared to group M, being able to observe great differences ($p \leq 0,05$).

The hepatic enzymes presented superior values on both groups, with the specification that the group supplemented with PG shows the tendency of a decreasing evolution toward normal values after 70 days post partum, compared to group M where AST presents an increasing tendency after the same period.

The total proteins and the serum urea presented superior values to both groups from birth until 70 days post partum, without noticing statistic significant differences.

From the point of view of the serum glucose and cholesterol evolution, it was observed that during the studied period they present superior values in group E (PG) compared to group M, more noticeable in day 70 post partum ($p \leq 0,05$) in case of glucose and day 15 post partum ($p< 0,05$) in case of cholesterol.

Smaller statistically significant values concerning the medium percentage of fat in milk were observed in group E compared to group M in the period 10 ($p = 0,001$), 30 ($p = 0,01$) and 50 ($p = 0,0004$) days post partum.

The realization of an administration protocol of PG in the farm determined the increase of the probability of the estrus manifestation in 50 days post partum and a significant improvement of the studied reproduction indicators, this way obtaining an efficient answer for the therapy of induction of estrum and ovulation.

All these data confirm once more the fact that the fertility of dairy cows is influenced by the metabolic stress to which they are submitted to during the puerperal period, especially if it is not solved through a proper feeding.

Moreover, the researches show that the easily obtained data, such as the protein-fat percentage in milk, the body condition score (BCS) can be used by the practitioners in this domain to analyze the fertility problems on farms and more concrete to examine if the metabolic stress is implicated in fertility problems through other factors.