

The Evolution of the Hemogram and Certain Biochemical Parameters from Blood and Milk of Sows During the first Week Post-Partum

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Abstract. Through hematological, biochemical and milk cell population investigations performed on blood and milk samples the developments in health and lactation in a group of 15 sows with piglets was monitored. According to the obtained results the investigated physiological parameters were characterized by wide variations, with the mean falling within the reference values for onset of lactation in sow and minor irregularities, with no pathological connotation. Erythrocyte indices showed significant oscillations, but with normal mean values for hematocrit (35.74%), associated with slight decreases in mean concentration of hemoglobin (8.20 g/dl), total number of red blood cells (5.78 T/l) and mean erythrocyte constants maintaining within the physiological limits. The evolution of the leukocyte subpopulation showed normal values for total number of leukocytes (6.9 to 14.9 G/l), except for two cases with leukocytosis, while revealing also an individual tendency towards neutrophilia (40-41%), lymphocytosis (50-51 %) and eosinophilia (16%) and a general tendency towards monocytosis (16-27%). Protein and energy index profile revealed normal proteins value (7.9 g/dl), albumins (5.74 g/dl) and globulins (1.97 g/dl). Glicemia showed a decreasing trends around a mean value of 81.9 mg/dl. GGT levels (31 to 49.5 IU) varied between physiological limits and alkaline phosphatase increased slightly around a mean of 215.2 IU. Blood ion levels showed normal values for magnesium (1.63 mg/dl), calcium (from 9.5 to 11.0 mg/dl) and phosphorus (6.78 to 9.14 mg/dl) for five sows, other two showing hypercalcemia (37.2 to 39.2 mg/dl) associated with an increased phosphorus level (23.21 to 23.83 mg/dl). Physico-chemical examination of milk has reported values normal for the opening period of sow lactation regarding protein content (7.97%) and to a lesser degree regarding solids (13.67%) and fat (8.18 %), the density having a value of 1.043 and a freezing point of 0.28 °C. The milk cell population was characterized by a near majority proportion of macrophages (40.87%), with lymphocytes (31.0%) and PMN leukocytes (15.8%) an important ratio falling to epithelial cells (12.33%).

Keywords: lactating sows, blood count, metabolic profile, lactocytogram.

INTRODUCTION

Sows have 3-10 pairs of mammary glands with 2-3 galactophore systems. Alveolar lobes are evident in gilts from the 45th day of life, but remain small and undeveloped during gestation, revealing only 4 days before parturition, when prolactin initiates lactogenesis. For some sows is characteristic a surge lactose content of colostrum 2 days before parturition and is negatively correlated with blood progesterone concentration. Noteworthy is that during galactopoesis the mammary epithelium of sows, synthesize and secretes daily, as milk protein, a quantity of material equivalent to 15% of their body weight.

Monitoring lactation in sows, as a health surveillance and growth of piglets is a very actual concern both in terms of research and practice. Ensure further progress requires, however, diversification and improvement of assessment methods and risk management which may affect lactating sows and piglets (Einarsson et al., 1993; Cotru Maria, 1984). In the context mentioned above fall the objectives of this study, consisting of assessment of hematological parameters and metabolic profile in a sample of lactating sows and the use of experimental models for the collection and investigation of sow milk.

MATERIALS AND METHODS

The research consisted of making observations on a sample of lactating sows with piglets, in the first week post-partum, forming 55 nests. From a randomized group of 15 lactating sows, blood and milk samples were collected for conducting clinical trials, hematological, biochemical and correlative milk cytology, in order to monitor the developments of health status and lactation.

Blood samples were collected on EDTA and serum stabilizer, by puncture of the jugular confluent, the sample thus obtained were used for the determination of haematological parameters (Ht, Hb, Number of Erythrocytes, mean erythrocyte constants, Number of Leucocytes, leukocyte subpopulations), using Abacus Junior Vet automatic analyzer and biochemical parameters (blood glucose, total protein, albumin, globulin, GOT, GPT, GGT, PAL, urea, CK, creative, Ca, Mg, inorganic phosphorus), using Vet scan VS2 automatic analyzer with Large Animal Profile kits.

For the collection of milk samples we evaluated several methods and from the obtained results we chose the manual milking procedure, coupled with the action of injecting a dose of oxytocine in case of 10 of the sows, and during feeding of 2-3 piglets for the other five sows. After collection, the milk samples were processed quickly, without requiring the addition of preservatives, then, the samples were subjected to physical, chemical and morphological investigations. The physicochemical tests were the determination of basic components (fat, SNF, protein), density, freezing point and added water, using the semiautomatic EKOMILK analyzer, and the morphological test included milk cell population from milk sediment on smears, degreased with xylene and benzene and colored panoptically (MGG and Dia - Quick panoptic).

Individual data were finally processed and analyzed statistically using current biostatistics program (Graph Pad Instat V3.0, Graph Pad Prism V4.0, Microsoft Excel).

RESULTS AND DISCUSSIONS

Erythrocyte indices showed large oscillations, but with mean values falling within physiological limits. In the hematocrit, individual developments have shown significant deviations compared to reference values (36 to 43%), with a recorded mean value of 35.74%. We noted however, slightly decrease the mean concentration of hemoglobin (8.20 g/dl), while maintaining the values within physiological limits of the mean total number of erythrocytes (5.78 T/l). Predominant oscillations were nevertheless below the reference values for both hemoglobin (9 to 13 g/dl) and the total number of erythrocytes (5 to 7 T / L) (Fig. 1). Mean erythrocyte constants had also large fluctuations of the mean values around the references, with slightly elevated levels for VEM (55 to 68 fl) and normal HEM (31.6 to 36.2 pg) and CHEM (18.1 to 22,4 g/dl).

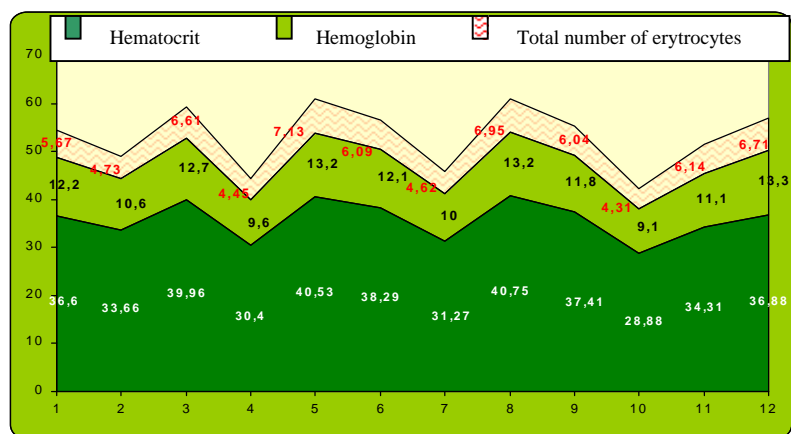


Fig. 1. Evolution of individual values of erythrocytes indices in the investigated sows

Leukocyte parameters were characterized by more or less important changes compared to the recommended references of some knowledgeable researchers in the field (Ognean et al., 2004; Cotru Maria, 1984). The relevance of these issues is clear from developments in the leukocyte population, which indicated a predominate fall between physiological limits for the total number of leukocytes (6.9 to 14.9 G/ l), except two cases with leukocytosis (19.5 respectively 20.0 G/l) (fig 2). We found slight irregularities in the distribution of leukocyte subpopulations, consisting predominantly of monocytosis (16-27%), recorded in all cases associated with two cases that showed neutrophilic trends (40-41%), two showing lymphocytosis (50-51%) and one eosinophilia (16%) (fig. 3).

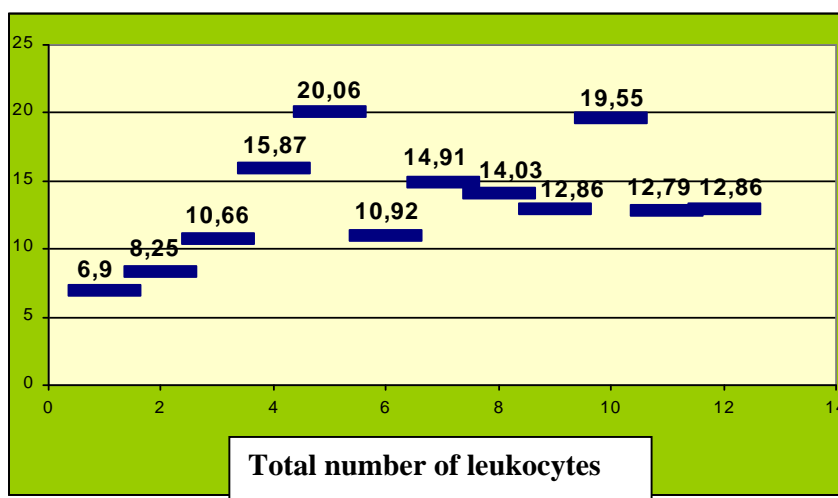


Fig. 2. Evolution of total number of leukocytes in the investigated sows

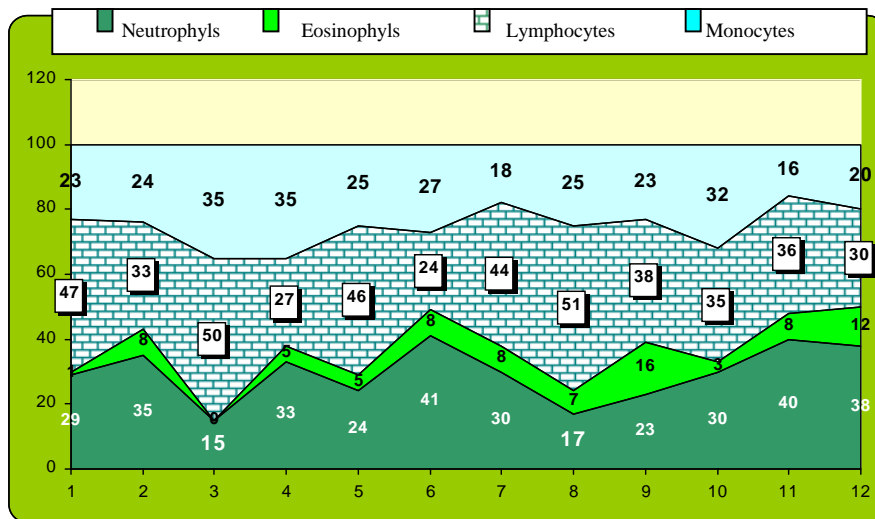


Fig. 3. Distribution of leukocyte subpopulations in the investigated sows

Regarding metabolic profile, the overall shape of the protein, energy and mineral metabolic parameters associated with basic enzymes was characterized by specific developments associated to pre-birth period and the onset of lactation sow (table 1). Regarding the dynamics of the main indices of the protein metabolism is noteworthy their fall between physiological limits, for total proteins (7.9 g/dl) ranging between 7.0 and 9.8 g/dl, albumins (5.74 g/dl) between 4.8 and 6.5 g/dl, and globulins (1.97 g/dl) between 1.3 and 2.7 g/dl. The same trend was found in urea, which presented a mean value of 31.59 mg/dl, values falling below the physiological limits in single case (8.13 mg/dl). Serum creatine levels have also evolved between physiological limits, the mean value being of 1.81 mg/dl, and creatinine which exceeded in three cases the mean value of 1142.00 mg/dl, reaching concentrations of 1837 mg/dl;

In the assessment of energy metabolic profile we considered relevant glucose margin evolution, including individual values between 70.2 and 95.9 mg/dl, with decreasing trends around a mean of 81.9 mg/dl. Dynamic interpretation serum ions we showed normal levels of magnesium (1.63 mg/dl) for the entire lot. Calcemia and phosphoremia presented, important oscillations from the physiological limits (18.33 mg/dl respectively 10.48 mg/dl) with normal mean values (9.5 to 11.0 mg/dl respectively 6.78 to 9.14 mg/dl) for most sows, with the exception of two cases with hypercalcemia (37.2 to 39.2 mg/dl) and hiperphosphoremia (23.2 to 23.8 mg/dl).

Enzymatic parameters were characterized also by developments clustered around the reference values. Thus, GGT levels varied between 31 and 49.5 IU, except for two cases which had slightly exceeded the upper limit (54.9 - 66.0 UI). More important, however, were alkaline phosphatase variations around the average of 215.2 IU, three of the investigated sows showed significant increases, up to 375.3 IU.

Analyzed in their entirety both the biochemical and hematological parameters showed trends falling in the larger context of the reference values corresponding to the onset of sows lactation, no significant deviations are reported and no pathological connotation (Cotru Maria, 1986; Ghergariu et al., 2000).

Investigation of the morphology and physiology aspects of cell populations and subpopulations, found in the milk samples of the investigated sows, we obtained encouraging

results for the initiation of novel research in physiology and pathology of mammary gland in sows. Looking ahead, the implementation tests regarding the health monitoring of lactating sows and piglets could be based on such research, as those used in clinical investigation on cows, goats or sheep (Ognean et al., 2004).

Tab. 1.

Values of the biochemical parameters in a group of lactating sows

No.Sample Parameter	1	2	3	4	5	6	7	Mean	References (Merk)
Glicemia (mg/dl)	70,2	95,6	79,6	83,5	84,2	86,7	73,5	81,90	66-116
Inorganic phosphorus (mg/dl)	8,6	7,4	9,14	6,78	8,42	23,83	23,21	12,48	5,57-24,76
Mg (mmol/l)	1,2	1,3	1,4	0,88	0,95	2,8	2,9	1,63	0,9-1,4
Ca (mg/dl)	9,66	10,64	11,0	11,1	9,52	37,2	39,22	18,33	9,2-11,6
Urea (mg/dl)	40,2	39,6	40,4	43,6	8,13	29,96	19,26	31,59	18-53
Creatin (mg/dl)	1,74	1,76	1,76	1,87	1,67	2,20	1,65	1,81	1,07-2,48
GOT (U/l)	51	49	52	54	62	58	48	53,43	15-55
GPT (U/l)	42	46	38	44	70	39	40	45,57	22-47
GGT (U/l)	49,3	42,6	54,9	66	37	31	45	46,54	31-52
PAL (U/l)	225,9	375,3	243,2	141,5	165	174	182	215,27	41-176
Total protein (g/dl)	7,5	7,0	9,8	7,18	7,5	7,7	8,6	7,90	6-9
CK(U/l)	1240	764	952	867	1370	1837	964	1142,0	66-489
Albumins (g/dl)	5,2	4,8	5,4	6,2	6,5	6,2	5,9	5,74	2,3-4
Globulins (g/dl)	1,6	2,7	1,5	2,5	1,3	1,5	2,7	1,97	3,9-6

Summary of the resulting data from milk cell population analysis performed on this limited group of sows, highlighted as common issues the predominance of macrophages (40.8%), followed by lymphocytes (31.0%) and PMN leukocytes (15.8%), and that particularity a substantial proportion of epithelial cells (12.3%) and presence of unidentifiable cellular structures (fig. 4). It is characteristic the distribution of the PMN leukocyte subpopulations identified in the composition of milk cell subpopulation, with a preponderance of neutrophils (75 to 100%) compared to eosinophils, which showed lower and very variable values (0 to 25%) and basophils, inconsistently reported.

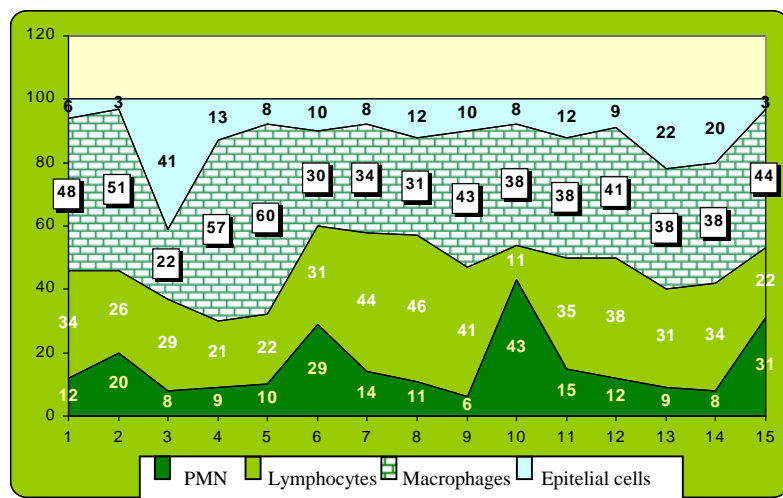


Fig. 4. Milk cell population configuration to sample from the investigated sows

The obtained data from the investigated milk parameters of 11 sows, showed the value corresponding to the onset of lactation period regarding protein (7.97%) and less in the dry non-fat substances (13.67%) and fat (8, 18%), the density being 1043, and freezing point 0.28 °C (table 2).

In the context of data, these values are more or less comparable with those reported by other researchers in the field, showing that in sows, the level reached by the main biochemical components of milk reflects nutritional value (Acie et al, 1999).

Tab. 2.

The evolution of the physico-chemical parameters of milk from the investigated sows

No sample	Fat(%)	SNF (%)	Density (g/cm ³)	Added water (%)	P. of freezing (°C)	Protein (%)
1	10,8	10,6	1,028	4,81	0,571	5,37
2	4,75	11,2	1,0361	0,0	0,618	5,77
3	4,61	11,2	1,036	0,0	0,621	5,81
4	1,71	19,9	1,076	0,0	0,0	13,3
5	9,28	11,2	1,0319	0,53	0,597	5,83
6	14,5	12,1	1,0309	10,3	0,538	6,71
7	7,2	14,5	1,0475	0,00	0,744	8,58
8	8,98	10,8	1,0308	0,0	0,588	5,54
9	13,6	12,6	1,034	6,68	0,56	7,15
10	6,15	18,5	1,0658	0,0	-0,954	12,1
11	8,35	17,8	1,0607	0,0	-0,835	11,5
Mean	8,18	13,67	1,0434	2,03	0,28	7,97

Compared to milk, colostrum is richer in the content of dry matter, protein, vitamins and minerals but poorer in fat and lactose. On the issuing of antibodies titers, specific for the colostrum of sows is the very rapid decrease in gamma globulins content, which requires

feeding of the piglets during the first hour after birth (Ognean et al., 2004, Persson et al., 1989; S I geanu G., 1980).

Testing of sow milk can give results regarding the detection of mastitis, usually initiated immediately after birth in association with metritis andagalactia, their effects consisting of reduction and significant alteration of milk secretion (Persson et al., 1989). Although we do not have data about the use of tests for detecting mastitis in sows, we believe that electrical conductivity, and cytologic examination could give conclusive results regarding this. Risk of mastitis in sows must be matched by galactopoesis progress. In this respect the risk remains high in the first three weeks after birth, when milk production continuously increases, in the fourth week remaining nearly constant, then begin to decline slightly in the sixth week, followed by a pronounced reduction until the end of lactation. Productivity of milk differs between glands, the glands situated near the chest, intensely vascularised, produce more milk than abdominal or pelvic glands. Thus, a sow can produce during an 8 week lactation 350-400 kg of milk containing 68-77 kg solids, 23-26 kg protein respectively, 24 to 27 kg fat, 17.5 to 20 kg of lactose, 3, 5-4 kg of minerals, requiring an appropriate feed ration in terms of quantity and quality (Persson et al., 1989). Noteworthy are also the many concerns regarding increasing milk production in sows, based on the prevailing effects of the injection of swine somatrophin or stimulation of prolactin secretion (Virolainen et al., 2004).

CONCLUSIONS

Hematological, biochemical and milk cytology investigations performed on the group of lactating sows in the first week led us to draw the following conclusions:

- The hematocrit, with mean values of 35.74%, evolved between physiological limits (36-43%), except for five cases of minor deviations;
- Hemoglobin concentration was below the reference values (9 to 13 g/dl), with a mean of 8.20 g/dl and predominantly oscillated below the minimum reference values;
- Total number erythrocytes presented mean values of 5.78 T/l, oscillating around physiological limits (5 to 7 T/l), with the exception of 5 cases situated below this level;
- Mean erythrocyte constants had values that fluctuated between the reference values, with slightly elevated VEM (55-68 fl) and HEM values (31.6 to 36.2 pg) values, CHEM values (18.1 to 22.4 g/dl) were normal;
- The evolution of the leukocyte count showed normal values of total leukocyte count (6.9 to 14.9 G/l), except in two cases with leukocytosis (19.5 respectively 20.0 G/l);
- Distribution of the leukocyte subpopulations showed individual tendencies towards neutrophilia (40 to 41%), limphocytosis (50 to 51%) and eosinophilia (16%) and a general trend towards monocytosis (16 to 27%);
- Indices of protein metabolism showed normal value of total proteins in serum (7.0 to 9.8 g/dl) albumins (4.8 to 6.5 g/dl) and globulins (1.3 to 2.7 g/dl);
- Glucose, regarded as an indicator of energy profiles presented predominantly normal values (95.9 to 70.2 mg/dl), with decreasing trends around the mean of 81.9 mg/dl;
- GGT showed levels generally within physiological limits, the oscillations ranging between 31 and 49.5 IU, except for two cases situated above the normal range (54.9 to 66 IU);
- Alkaline phosphatase has evolved around a mean of 215.2 IU, in 3 cases the levels increased to 243.2 IU;

- Urea levels presented mean values of 31.59 mg/dl, individual levels falling below the physiological limits in only one case (8.13 mg / dl);
- Serum creatine evolved between physiological limits, with mean values of 1.81 mg/dl, and creatinine which exceeded in three cases the mean of 1142.00 mg/dl in reaching concentrations of 1837 mg/dl;
- Mineral profile included normal values for magnesium (1.63 mg/dl) and in the case of 5 sows for calcium and phosphorus (9.5 to 11.0 mg/dl respectively, from 6.78 to 9.14 mg/dl), other 2 cases showing hypercalcemia and hiperphosphoremia (37.2 to 39.2 mg/dl, respectively from 23.21 to 23.83 mg/dl);
- Physico-chemical examination of milk has reported values characteristic for the onset of lactation period for protein (7.97%) and less for non-fat substances (13.67%) or fat (8.18%), the density being 1043 and freezing point 0.28 °C;
- Milk cell subpopulation in sow showed a characteristic configuration with the predominance of macrophages (40.87%), followed by lymphocytes (31.0%) and PMN leukocytes (15.8%), an important fraction being epithelial cells (12.33%).

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