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CORRELATIVE ANALYSIS OF THE EVOLUTION OF GLYCEMIA AND BODY WEIGHT FOR NEWBORN PIGLETS

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Abstract

In a multiplier PIC farm were effectuated complex surveys in order to monitor the health of suckling piglets and of lactating sows, by centering recorded data from the actual situation on field and the correlative analysis of glycemia and body weight level of 18 lots of newborn piglets (n=167) respectively the glycemia of the sows. The testing of glycemia was done using Accu-Chek Active glucometre, utilizing drops of freshly sampled blood, by sectioning the tip of the newborn piglets' tail, respectively by puncturing the pinna of sows. The inquires also included the taking of biometric measurements, consisting of individual weightings of piglets at the moment of parturition and at the moment of weaning. The data obtained on pairs: lot of suckling piglets – lactating sow were statistically analyzed using the Categorial analysis system ANOVA (Unpaired t test for Probability index calculation "P" and linear regression analysis to calculate the Pearson correlation coefficient "r" and for determination of "r^2"). Statistical analysis of recorded data from the sample of newborn piglets revealed high average values of glycemia in first hours after parturition (97.329±10.499 mg/dl), having a rising trend (107.01±7.378 mg/dl) in the next 10-15 hours, in terms of weights between 1.8 and 2.1 kg/piglet. It should also be noted that the piglets have reached an average weight of 7.3 kg at weaning, achieving an average gain of 5.5 kg during the lactation period (21 days). At newborn piglets, glycemia levels increased significantly statistically (p = 0.003) after the first suckling and were positively correlated (r = 0.4945) with the values of their weight at parturition. Noteworthy is the insurance statistics (p = 0.001) of weight gain of the lots of piglets in interval between parturition and weaning (growth spore). According to these correlations, elevated glucose levels can be associated with the weight gain of newborn piglets. Less interesting proved to be the results obtained by monitoring the glycemia of mother sows, who have variations between 50 and 133 mg/dl, with insignificant deviations to physiological ranges of species and category (66-116 mg/dl).

Key words: *piglets, weight, glycemia, mother sows.*

INTRODUCTION

The energetic influx through colostrum and milk is limited in the case of newborn piglets, which affects their immediate survival after parturition and increases the risk of mortality. Thereby, in the first days of life the losses of suckling piglets can reach at 12% being followed also by a reduction in the rate of growth after weaning or even later. At birth, the piglet's glycogen reserve is about 271 kilojoules, and it requires an external source of energy in the first hours of life to prevent hypoglycemia. Such an energy source may be represented only by the colostrum, which contains from 586 to 628 kJ/100 ml. However, it is considered that a newborn piglet needs to consume 250-300 ml colostrum to balance energy (Crenshaw, 1989).

Piglets are born with low organic reserves, thereby energetic influx from milk right away after parturition is essential for surviving. In case of low production of milk during lactation, some long-term effects will exist, which consist in a reduction in the rate of growth after weaning and even the entire period of growing and finishing. Thereby, even in the case of an adequate management, newborn piglets can reach only a part of their growth potential (Halamek et al., 1997). In general, milk production of sows may become a limiting factor for the growth of piglets in about 8-9 days of lactation (Ognean et al., 2015). Moreover, the differences between the needs of

piglets for nutrients from milk and its contents, progressively increase during lactation. In fact, the level of milk production acts as a limiting factor of piglets' optimum growth, whether they are weaned at 14, 21 or 28 days. On the other hand, current strategies of early weaning, about 14 days, only serve to intensify the difficulty of ensuring the necessary for growth and development of the lot of piglets at birth, before weaning. It is believed that fat oxidation for energy purposes is quantitatively lower than the amino acid/ glucose substrate, specific for the oxidation during fetal life, therefore also explaining the ketogenesis low rate of newborn piglets.

MATERIALS AND METHODS

In a PIC multiplication EUROHYB farm were conducted complex surveys to monitor the health of suckling piglets and lactating sows. According to implemented technological standards in this complex, preparturiented sows and those who are lactating with suckling piglets are maintained in maternity compartment, including proper boxes for maintenance and feeding requirements and also for the size of the calving group. For the undertaken surveys we have resorted to using the couple "lot of suckling piglets and lactating sows" as the unit of study. From all assessments conducted, in this paper we intended to make a detailed analysis of the correlative evolution of the glycemia levels, body weight and achieved gain of newborn piglets during the lactation period, respectively glycemia of lactating sows. Recorded data were correlated with high levels of performance indexes made by the investigated farm. From their synthesis appears that those 186 breeding sows, components of livestock jelly, conducted a total of 411 births annually, which resulted in 5238 calving piglets, respectively 4946 weaned piglets, resulting in 27.1 piglets/year/sow.

Monitorization of glycemia and ecometric indices consisted in correlative investigating of glycemia evolution and body weight of suckling piglets (n=176) from 18 "nests", taken randomly, respectively glycemia of those 18 mother sows. Biometric measurements were conducted and focused on weighing piglets from investigated nests and also the determination of individual weight gain and average (per lot and sample), based on the difference between the initial weight values (at birth) and final (at weaning).

Glycemia testing was based on using the quick method with Accu-Check Active glucometre provided with approved kits by Roche Diagnostics GmbH. The adopted method for glycemia testing required several adaptations of technical instructions to the working conditions in maternity and especially to the specific biologically fields accounted by newborn piglets and calving sows. Among these are used as area of election the tip of the tail for piglets, respectively pinna for sows; grooming (washing with soap and warm water), disinfection (with sanitary alcohol) and drying (by swinging) the election area; harvesting of blood drops in small caliber syringes (1 ml), by puncture of a vein pinna of sows, respectively severing the piglets' tip of the tails. The adoption of these collecting procedures allowed us to deposit correctly the drop of blood into the test strip and read the result in the indicated time (90 seconds). Statistical analysis of experimental variables included grouping of primary data, followed by their processing using Operating System Windows 2010 and GraphPad In State Program (functionally integrate in system by categorical analysis ANOVA). From this program, for processing the obtained data, Unpaired "t" test was used. Using this test allowed the evaluation of the probability index value "P", based on comparative analysis of initial (i) and final (f) weight, also by initial (i) and final (f) glycemia. We also appealed to simple linear regression analysis, which allowed evaluating correlations between initial glycemia (i) and the initial (i) and final (f) weight. They were quantified by expressing the Pearson correlation coefficient (r) and the coefficient of determination (r^2), which indicates the validity of the analysis model.

RESULTS AND DISCUSSIONS

The overall evolution of glycemia levels in the newborn piglets was characterized by tight oscillations influenced by the time elapsed after the first suckling. They were positively correlated with weight of piglets at birth, but

without important influences on the achieved gain during lactation. Therefore, according to data presented in Table 1, the results of statistical analyzes revealed the framing of average values of glycemia for the lots of newborn piglets in the range 93.75 - 112.4 mg/dL in the first 5 hours after first suckling respectively within 91.0 to 109.8 mg/dL in the first 15 hours after first suckling.

Calculated on the entire sample of newborn piglets, average values of glycemia reached 97.329±10.499 mg/dL at the first measurement (1-5 hours after parturition) and 107.01±7.378 mg/dL in the second measurement (10-15 hours after parturition), in conditions of weight between 1.8 and 2.1 kg/newborn piglet. We also note that pigs reached an average weight of 7.3 kg at weaning (67.3 kg/lot), achieving an average gain of 5.5 kg during the lactation period (21 days). Less interesting proved to be the obtained results from monitorization of glycemia of mother sows, who presented variations between 50 and 133 mg/dL, with insignificant deviations to physiological ranges of species and category (66-116 mg/dL).

The results of the statistical analysis are relevantly expressed through correlations and comparisons presented in Table 2. They show a significant increase (p= 0.003) of the glycemia level to newborn piglets after first suckling, recording averages of 97.329± 10.499 mg/dL in interval between 1-5 hours and 107.01±7.378 mg/dL in an interval of 10-15 days after parturition. We attributed special relevance to positive correlation (r=0.4945) between average values of glycemia and of piglets' weight at birth, which was statistically ensured by the values of P (0.0370) and of r^2 (0.2445). It also should be noted the statistical insurance (p = 0.001) of weight gain of lots of piglets in interval between parturition and weaning, representing the achieved gain growth during the lactation period, having a duration of 21 days. These correlations show a possible association of elevated glycemia with increased weight of newborn piglets. We attributed special importance and negative correlation (r=-0.0682), without statistical significance, between the initial glycemia and the weight of piglets at weaning.

As the data shown in Figure 1 illustrates, it a pretty tight grouping of glycemia values of the lots of piglets around the sample's averages was noted (97.329 ± 10.499 mg/dL at 1-5 hours, respectively 107.01±7.378 mg/dL at 10-15 hours after parturition).

Table 1. Glycemia values in piglets groups at 1-5 hours (^{i}) and at 10-15 hours after parturition (^{f}) and values of body weight at parturition (^{i}) and at weaning (^{f})

Parameter	Weight^i (kg)	Glycemia^i (mg/dl)	Weight ^{f} (kg)	Glycemia^f (mg/dl)
Lot 1 (n = 13)				
Mean	1.738	98.923	7.333	100.616
St.dev	0.138	14.499	0.359	8.781
Lot 2 (n = 13)				
Mean	1.8	96	7.285	104
St.dev	0.147	17.306	0.791	7.417
Lot 3 (n = 13)				
Mean	1.685	94.231	7.283	95.846
St.dev	0.408	17.838	0.799	19.274
Lot 4 (n = 13)				
Mean	1.833	112.417	6.975	110.333
St.dev	0.227	12.0789	0.691	7.596
Lot 5 (n = 12)				
Mean	1.833	112.417	6.975	110.333
St.dev	0.227	12.0789	0.691	7.596
Lot 6 (n = 13)				
Mean	1.554	86.923	7.292	105.154
St.dev	0.357	17.299	2.158	9.607
Lot 7 (n = 13)				
Mean	1.769	99.385	7.169	108.625
St.dev	0.184	13.593	0.6223	9.078
Lot 8 (n = 12)				
Mean	2.075	102.083	7.792	105.667
St.dev	0.076	6.402	0.405	6.315
Lot 9 (n = 13)				
Mean	1.8	109.923	7.646	115.158
St.dev	0.1224	7.308	0.504	6.780
Lot 10 (n = 13)				
Mean	1.866	104.167	7.272	117.417
St.dev	0.172	9.656	2.120	9.090
Lot 11 (n = 13)				
Mean	1.815	92.769	7.7	109.846
St.dev	0.199	18.226	2.176	17.411
Lot 12 (n = 12)				
Mean	1.883	104.667	7.633	119. 667
St.dev	0.175	16.511	0.556	18.855
Lot 13 (n = 12)				
Mean	1.8	93.75	7.342	110.083
St.dev	0.105	7.534	0.609	7.452
Lot 14 (n = 14)				
Mean	1.736	86.5710	6.992	106.769
St.dev	0.321	15.589	2.624	30.481
Lot 15 (n = 11)				
Mean	2.0	99.272	7.645	111.727
St.dev	0.054	4.859	0.508	6.929
Lot 16 (n = 9)				
Mean	1.733	71.111	7.4	97.555
St.dev	0.123	19.212	0.505	5.854
Lot 17 (n = 9)				
Mean	1.877	102.111	7.489	91
St.dev	0.109	18.811	0.321	21.354
Lot 18 (n = 10)				
Mean	1.72	85.2	7.5	106.4
St.dev	0.130	22.375	0.349	5.834
Samples (n= 167)				
Mean	1.806	97.329	7.373	107.1
St.dev	0.115	10. 499	0.250	7.378

^{i}- initial; ^{f}- final

Table 2. The obtained values at statistical analysis of investigated parameters

Correlations	
Level	r
Glycemia^{i}/ Weight^{i}	0.4945
Glycemia^{i}/ Weight ^{f}	- 0.0682
Level	r^2
Glycemia^{i}/ Weight^{i}	0.2445
Glycemia^{i}/ Weight^{f}	0.0046
Level	P
Glycemia^{i}/ Weight^{i}	0.0370
Level	P
Glycemia^{i}/ Weight^{f}	0.7878
Comparisons	
Level	P
Weight^{i} / Weight ^{f}	0.001
Glycemia^{i}/ Glycemia^{f}	0.003

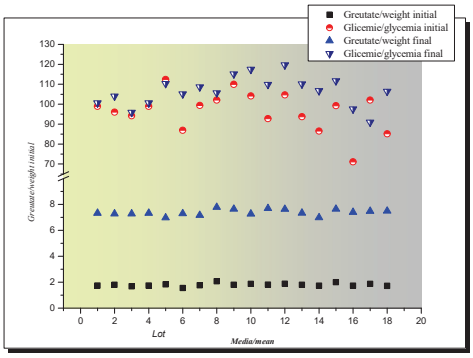

Fig. 1. Comparative evolution of medium values of glycemia and body weight in piglets groups which were investigated

Compared with the values found by us, most researchers in the field report lower levels of piglets' glycemia in the first hours after parturition reported by (Rada et al., 2010). We think that rising trend of glycemia for newborn piglets represents a characteristic feature for PIC breed, respectively for the investigated hybrid line. In same context can also be registered the higher glycemic levels (66-116 mg/dL), and the upward trend in suckling piglets, also recorded by other researchers of the field (Vlasiu et al., 2012). According to other research în field, the increases of glycemia and of weight of suckling piglets were assigned also to high level of milk production in PIC sows (Ognean et al., 2015). However, in our study, the average values of glycemia of mother sows presented less important oscillations in the interval of 50-133 mg/dL, the crossings of the upper limits being registered for only a few cases.

The suckling piglets' metabolism is characterized by intensification of catabolic processes and functional deficiency of the enzymatic equipments which reduces their capacity for synthesis. In these circumstances, piglets' glycemia is lower than that of adult swine, and is located around the value of 83 mg/dL (Rada et al., 2010). To all these it is added the inefficiency of energy metabolism and thermoregulation, which requires increased consumption of carbohydrates. The analysis of glycemic evolution of investigated lots confirms that, for the newborn piglets is essential to maintain this parameter in physiological limits, their limited hepatic glycogen reserve being known.

It is appropriate to notice that since the parturition, the transplacental transfer of glucose ceases, which means that the elapsed period until the first feeding is extremely critical, the stabilizing of the newborn being therefore dependent on their own deposit of hepatic glycogen. In such circumstances, the presence of an appropriate reserve for hepatic glycogen at parturition will increase the survival rate of piglets during this transitional period. It is important to observe that the decline of glycemia appears immediately after parturition and lasts 1-3 hours, because of the quick depletion of hepatic glycogen and compensation of this deficiency through enhanced gluconeogenesis only in the first hours after parturition (Pabst and Rothktter, 1999). It is important to mention that this critical time is amplified also by the metabolic requests of the state of lactation, which are higher in sows than females of other species of mammals, their lactopoesis requiring higher energy and mineral consumption (Acie et al., 1999) . On the other hand, the prevalence of catabolic processes of lactating sows justify why their case should be linked to energy and nutrients requirements to milk production and weight loss (Ognean et al., 2015).

In precarious conditions of feeding, weight losses in lactating sows can up to 40%, which seriously affects their productive performance. As we have already mentioned, after the suspension of maintaining glycemia by transplacentar transferring, the survival of newborn piglet requires adequate hepatic glycogen reserves available until the first sucking (Herpin et al., 2001; Kim et al., 2000). In this regard are relevant the results of studies

conducted on rats, which showed delay in the growth of fetuses with lower hepatic glycogen reserves than normal (Grupposo and Brautigan, 1989). In this context are registered also severel data of research conducted on human models and animals, showing that glucose is the primary energy source of the fetus, while the accumulation of nitrogen and protein are essential components for fetal growth (Hay, 2006; Hiridis et al., 2016). For the human fetus that reached term, hepatic glycogen concentration is 80-180 mg/g of tissue, this concentration being higher than at any other stage of life. In the case of swine the reserves of glycogen body are between 30-38 g/kg body weight (Okai et al., 1978). At newborn piglets, diminution of glycemia leads to depletion of hepatic glycogen and to replacement of gluconeogenesis process with the glycogenolysis. In the context of current developments, it is considered that hypoglycemia, hypothermia and hypoxia of newborn piglets are not pathological conditions themselves, but rather the symptoms of a failure of adaptating during critical postnatal period.

CONCLUSIONS

The high level of glycemia recorded in newborn piglets (n=167) in the first hours after parturition (97.329±10,499mg/dL) with an upward trend in the next 10 to 15 hours (107.01±7.378 mg/dL), reveals that precocity of the first sucking, along with thermoregulation management and oxygen consumption are essential processes for their survival in postnatal period.

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