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A SCREENING OF MORTALITY EVOLUTION IN 49 PIG FARMS IN WESTERN ROMANIA

UN SCREENING AL EVOLUȚIEI MORTALITĂȚILOR ÎN 49 FERME DE PORCI DIN VESTUL ROMÂNIEI

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ABSTRACT | REZUMAT

The mortality of pigs on commercial farms is a significant loss that cannot and will not be completely eliminated, but only reduced to some economically bearable values. Thus, in this study, we aimed to make a comparison between two models of pigs breeding in western Romania, in intensive system type A (large capacity) and type B (small capacity). The experiment was carried out over a year, taking into account over half a million pigs, from 49 breeding units located in three counties. Farms have a different approach from a therapeutic point of view, so they were classified into four groups depending on the mortality rate, the level of expenditure, and the value of the treatments applied. In the present study, we started from a minimum mortality rate of 0.09%, this value is considered excellent, and at the opposite pole of profitability, we found some sporadic cases with the mortality values of 11.04%. The standard deviation of mortality between the quantified units was 2.058%, and the median was around 4.44% so that from an economic point of view, most units met the profitability scale.

The largest proportion of farms was into the second category (51.22%), followed by the third category (29.27%), and the first category (15.85%). On the last place was category IV (3.66%), which includes farms with a high mortality rate. This classification shows that the units in the first three groups fall into the category of eligible expenditure which does not put much pressure on the investment budget, and only categories I and II have been profitable because they meet the rate of relative profitability to the mortality rate. In conclusion, the costs of prevention and treatment of animals on type B farms were higher compared to those of type A, which resulted in a lower incidence of mortality in small capacity units (type B) compared to large capacity units (type A).

Keywords: swine, mortality rate, commercial farms, Western Romania

Mortalitatea porcilor din fermele comerciale reprezintă o pierdere însemnată care nu poate și nu va fi eliminată în totalitate, ci doar diminuată la niște valori suportabile din punct de vedere economic. Astfel, în acest studiu ne-am propus să realizăm o comparație între două modele de creștere a porcului, în sistem intensiv de tip A (de capacitate mare) și de tip B (de capacitate mică), din vestul României. Experimentul s-a desfășurat pe parcursul unui an calendaristic, s-au luat în calcul peste jumătate de milion de suine, din 49 de unități de creștere aflate în trei județe. Fermele au o abordare diferită din punct de vedere terapeutic, astfel au fost clasificate în patru grupe, în funcțe de rata mortalității, nivelul cheltuielilor și valoarea tratamentelor applicate.

În studiul de față s-a pornit de la un minim al procentului de mortalitate de 0,09%, aceasta valoare fiind considerată una excelentă, iar la polul opus al profitabilității, am întâlnit câteva cazuri sporadice, cu valori maxime ale mortalității de 11,04%. Deviația standard a mortalității între unitățile cuantificate a fost de 2,058%, iar mediana s-a situat în jurul valorii de 4,44%, astfel că din punct de vedere economic, majoritatea unităților au îndeplinit baremul de rentabilitate. Ponderile cele mai mari au fost obținute la fermele încadrate în categoria a II-a (51,22%), urmată de categoria a III-a (29,27%) și categoria I (15,85%). Pe ultimul loc au fost fermele din categoria a IV-a (3,66%), unde sunt încadrate fermele cu o rată ridicată a mortalității. În urma acestei clasificari rezultă că unitățile situate în primele trei grupe se situează în categoria cheltuielilor eligibile care nu pun o presiune mare asupra bugetului de investiții, și doar categoriiile I și II au fost profitabile deoarece îndeplinesc baremul de rentabilitate raportat la rata mortalității. În concluzie costurile cu prevenția și tratamentul animalelor din fermele de tip B au fost mai ridicate comparativ cu cele de tip A ceea ce a rezultat o incidență a mortalității mai scăzută în unitățile de mică capacitate (tip B) comparativ cu unitățile de mare capacitate (tip A).

Cuvinte cheie: suine, rata mortalității, ferme comerciale, Vestul României

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The mortality of pigs on commercial farms is a significant loss that cannot and will not be completely eliminated, but only reduced to some economically bearable values. We lose pigs at different ages and different weight categories, from newborns to those in the finishing phase and more importantly in breeding sectors, where the genetic basis is affected by the loss of valuable specimens for breeding (1, 6).

The causes of these losses depend on factors that may vary according to the management of the units, the state of health of the individuals, the conditions of accommodation, and the microclimate (4). It is a complex process that requires a good understanding of this phenomenon by manufacturers in order to solve problems that may be associated with production disruptions (14, 15). Population expansion and the increased need for meat in the human diet have led to evolutionary changes in the biological nature of breeding breeds by increasing the prolificacy of sows that are more likely to produce offspring than is to grow, and this trend has been exacerbated by current conditions in farms, by genetic selection (11, 12, 13). In the literature, the mortality rate of pigs is described as a multifactorial complex influenced by many endogenous and exogenous factors. Livestock agglomerations, which are typical for commercial holdings, have this problem by definition, and efforts to reduce the negative economic impact involve several strategies and methods (4). Therefore, the purpose of this study was to compare two types of farms from the area under study on intensive pig farming models in western Romania. The objectives of this study were to monitor the number of farms and the mortality rate of pigs in farms from the counties of Timiș, Arad, and Caraș-Severin; classification of farms by mortality rates; grouping farms by expenditure categories with treatment and budgetary impact; the influence of endogenous and exogenous factors on mortality by age categories and types of farms; assessment of treatment and prevention costs and their impact on mortality / frequency of mortality and treatments.

MATERIALS AND METHODS

The pig farms description

This study was carried out over a year, taking into account over half a million pigs, from 49 breeding units located in three counties in western Romania. The 49 units are located in the plain part of the study area, due to the relief and climate favorable to pig breeding, thus 35 units in the south-west of Timiș County, 13 units in the north-west of Arad County, and one unit in the west of Caraş Severin County (Fig. 1).

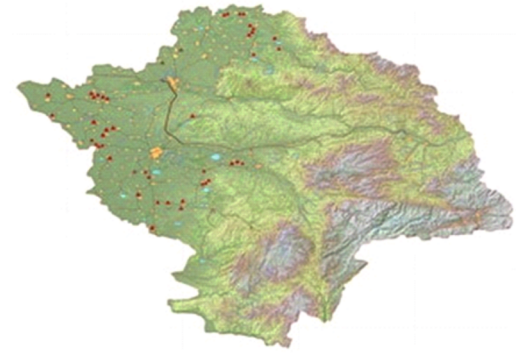

Fig. 1. Location of studied farms in western Romania

According to their destination, the pig breeding units in Romania can be classified as farms: of large capacity (with numbers between 20,000 and 45,000 pigs); of small capacity (with a population of 8,000 pigs); for reproduction, (so-called maternity hospitals). The total number of pigs studied in this work is shown in Table 1.

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistics program (Version 2.1) and data on the mortality rate in the units were taken into account. Also, in the same analysis was evaluated the value of the treatments as well as the vaccinations and their impact on mortality in the units studied.

RESULTS AND DISCUSSIONS

From the economic calculations of the farmers who own pig breeding units in the western area of Romania, it appears that the economically acceptable mortality must not exceed 5.5%, this being the maximum allowed value for the pig farms to be profitable. Depending on the nature and destination of the production unit, in the present study, we started from a minimum mortality rate of 0.09%, this value is considered ideal, those units that recorded these values being very profitable. At the opposite pole of profitability, we have met

Table 1

The total number of pigs/county

Category	Boars	Sows	Youth				Fat pigs	Total
			Infants	Fattened	Boared	Sows		
Arad	-	-	-	12158	-	-	74021	86179
Timis	313	45269	73237	140523	26	10907	224734	495009
Caraș S.	-	-	-	-	-	-	6117	6117
Total	313	45269	73237	152681	26	10907	304872	587305

Table 2

Statistical analysis of mortality and the value of treatments and vaccinations

Category		Percent	Medication /	Vaccine /
N	Valid	82	82	82
	Missing	0	0	0
Mean		4.5191	9.8209	.8209
Median		**4.4450**	**9.0839**	**.3755**
Mode		5.63	.16[a]	.00
Std. Deviation		2.05887	4.96719	2.51644
Variance		4.239	24.673	6.332
Range		10.95	24.90	15.00
Minimum		.09	.16	.00
Maximum		11.04	25.06	15.00
Sum		370.57	805.31	67.31

[a]. Multiple modes exist. The smallest value is shown

in a few cases values above the limit allowed by farmers, with maximum mortality values of 11.04%. From an economic point of view, these values / units were non-economic, far exceeding the maximum allowed threshold for a farm to be considered profitable. Compared to Belgium, which is a country with a tradition in pig farming, where average mortality rate of 4.70%. This difference can be made on the basis of the longer duration of the fattening period compared to our country (12). In a study conducted in the USA (1997), the average annual mortality risk of 5.68% was calculated using multiple regression (used as a calculation function to determine the factors associated with the annual mortality risk) and by analysis of variance (for comparison of mortality risks between study and seasonal groups) (6). The statistical analysis regarding the evolution of mortality in the farms under study was around 4.44%, thus economically the farms fulfilled the profitability scale (Table 2).

In Greece, was applied a data parameter analysis technique to investigate the efficiency of commercial pig breeding units. This technique, in which all statistical variables were normalized, indicated that variation offers ample potential for the correct use of resources in pig farming. The variation between farms is considered an important analysis criterion for evaluating the measures implemented in the breeding units, the authors reporting a value of 1.4% of the efficiency of the commercial breeding units (1, 7).

As shown in Table 2, the standard deviation of mortality between the units quantified in the study was 2.058%. This value can be explained by the fact that farms have a different approach from a therapeutic perspective, this being directly proportional to the incidence of diseases reported at the unit level and of course in correlation with farm management. The processing of data from farms provided the possibility of classifying the units by percentage intervals in terms of the evolution of mortality. Thus, the farms from this study were classified into four categories (Table 3): Category I - range: **0.00% - 2.75%**; Category II - range: **2.76% - 5.51%**; Category III - range: **5.52% - 8.27%**; Category IV - range: **over 8.28%**.

The highest part of farms falls into the second category (51.22%), followed by the third category (29.27%), first category (15.85%), and on the last place in our ranking - category IV (3.66%- farms with a high mortality rate). This classification of farms shows that the units from categories I and II were profitable because they meet the rate of profitability relative to the mortality rate. In our study, these two categories accounted for 67.07% of the total farms.

The observations also revealed that all these values are influenced by the therapeutic management of the farms, thus we evaluated the costs of the therapeutic protocols applied per individual in the units. Grouping farms according to economic analysis is essential nowadays, to highlight the budgetary impact of treatments in relation to their efficiency. As in the case of the mortality assessment, we classified the farms according to the level of expenditure with the medicines used in the prevention and treatment of pigs.

Farms were classified into four groups, according to the level of expenditure and the amount of treatment applied: Group I - range 0 - 6.26 pecuniary units*/ individual; Group II – range: 6.27 - 12.52 pecuniary units/individual; Group III – range: 12.53-18.79 pecuniary units/individual; Group IV over value: 18.80 pecuniary units/individual.

*Note: * consisting of / or measured in money*

Most farms were included in group II, in a proportion of 59.76%, followed by those from group III

Table 3

Classification of farms according to their mortality rate and profitability

Category / range	Mortality rate%	Farms	Profitability
I	0 – 2.75	15.85%	√
II	**2.76 – 5.51**	**51.22%**	√
III	5.52 – 8.27	29.27%	x
IV	8.28 +	3.66%	x

with 18.29%, group I with 15.85%, and group IV, with 6.10%, where the highest expenses with medication / individual were reported. As can be seen in Table 4, the first three groups can fall into the category of eligible expenditure, which does not put much pressure on the investment budget provided for the control and prevention of diseases in pig breeding units.

The evolution of mortality by age categories in the most important farms (type A) from the total of the units being studied shows us higher mortality rates in the case of pigs in the fattening sectors compared to the youth category.

In B-type farms,where there are no separate sectors by age categories, due to the All-In–All-Out (AIA O) system, the evolution of mortality was linear and quantified throughout the group taken into account. Piglet mortality from birth to weaning has increased to 16-20%, the major causes being attributed to death by crushing and starvation. However, these causes mask the real predisposing factors, which are mainly related to the sow biology and the neonatal and maternity environment. The higher risk of mortality in breeding females was associated with larger herd size, higher parity in calving, and a shorter duration of lactation, in this way the piglets are unable to survive asphyxia during birth, hypothermia after birth, and intense competition for colostrum among newborns.

Data provided by the National Animal Health Monitoring System from USA (NAHMS) (2001) indicate that, on average, a sow's prolificacy is 10.9 piglets, of which 10.0 are born alive and only 8.9 they will be able to survive to the age of weaning (3, 6, 16).

Following our research, following batches of pigs from different farms, from weaning to slaughter (for about 6 months), we found mortality rates of 4.23% in type B and 4.51% in type A farms. This percentage difference between low-capacity type B farms and high-capacity type A farms can be associated with a decrease in the size of the group and an increase in the feeding and watering space for individuals, which has reduced morbidity and mortality and increased growth rate at 8 weeks after weaning, resulting in heavier pigs at 24 weeks after weaning for smaller groups (2).

Of the previous total mortality recorded in type A farms, representing the arithmetic mean of pigs that succumbed to various causes, 34% were piglets at weaning and post-weaning age, and 66% were pigs in the fattening/finishing sectors. In the case of type B farms, the percentage values were similar: 36% mortality in youth and 64% in adults. Adult mortality was consistently higher compared to youth mortality, as reported by other authors. The increased incidence of mortality occurs mainly in older and economically valuable pigs and is unpredictable (11, 15).

Modern production systems are complex sets of processes that require knowledge and solution of the factors associated with disruption of production, thus reducing losses due to mortality. Previous studies on the success of post-weaning piglets have described the importance of infectious causes as major risk factors and the welfare issue that can influence the mortality rate of farm animals (14).

In the case of our study, following the clinical examination, autopsies, anatomopathological examinations and laboratory examinations, it was concluded that swine youth from farms in western Romania die mostly due to bacterial diseases caused by *Streptococcus suis* and *E. coli*., followed but in a much smaller percentage by technopathies. *Streptococcus suis* was the most common agent in youth mortality (68-70%), followed by *E. coli* (30-31%) and technopathies, which in our study was below 1%. Although farmers reported that a large proportion of the piglets that succumbed were due to technopathies related to calving systems, and the crushing of healthy piglets was the most common cause of death. They also claim that, in open systems, the incidence of crushing was higher, compared to the modular system consisting of individual cages with separators (5, 13). Reducing piglet mortality requires the application of breed improvement measures by incorporating survival traits into genetic selection objectives, optimizing nutrition, and appropriate environmental conditions that will facilitate the delivery of more viable piglets. Although it has been argued that some weaned piglets require more care or specific therapeutic interventions, their identification is often subjective and inconsistent and, for this reason, clear criteria are needed to identify weaned pigs that are less likely to survive and those with low growth during the nursery phase (3, 8,15, 18). In the hibernal period, in the case of adult pigs, the situation changes, thus the mortality rate increases compared to the youth category and differs significantly, depending on the type of farm, also differ the specific pathology of pigs in fattening sectors compared to those in youth sectors. In this category, bronchopneumonia and Hemorrhagic Bowel Syndrome (HBS) were the leading causes of mortality. In the opinion of the breeders, the leading cause of deaths in

Table 4

Grouping farms according to the value of expenses/individual

Group	Expenses/ individual	Farms	Profitability
I	0 – 6.26	15.85%	√
II	**6.27 – 12.52**	**51.22%**	**√**
III	12.53 – 18.79	29.27%	√
IV	18.80 +	3.66%	x

Table 5

The influence of the season on the main diseases in pigs

Afection	Winter	Summer	Winter	Summer
Bronhopneumonia	48%	44%	49%	43%
HBS*	42%	45%	41%	46%
Digestive disorders	10%	11%	10%	11%

**Hemorrhagic Bowel Syndrome*

Table 6

Correlation between mortality rate and investment of farmers

Category		Mortality	Medication /
Mortality rate (Binned)	Pearson Correlation	1	**,382****
	Sig. (2-tailed)		**,000**
	N	82	82
Medication / animal (Binned)	Pearson Correlation	**,382****	1
	Sig. (2-tailed)	**,000**	
	N	82	82

***. Correlation is significant at the 0.01 level (2-tailed).*

the cold season was associated with the increased incidence of respiratory problems during the production/ finisher phase, data also presented by the results of studies conducted under the National Animal Health Monitoring System in the United States (9, 10). The estival period was also associated with a higher risk of mortality by digestive disorders compared to the cold season where respiratory diseases were the leading cause of mortality (6). The evolution of the diseases is influenced by climatic and technological factors and is presented in the Table 5. The difference between the two seasons is explained by the large temperature variations in the shelter and the external environment. In the hibernal season, the shelters are heated and cold air enters through ventilation openings so that this impact determines the increase of respiratory diseases. While in the estival period, the ambient temperature is high, and the difference of temperature between the internal and external environment is insignificant, thus it appears heat stress and behavioral changes (pigs are agitated, looking for a cold place, and roll in manure). These behavioral deviations corroborated with body weight can lead to topographic-visceral changes, resulting in the increased incidence of HBS (Hemorrhagic Bowel Syndrome). About 11% of pigs affected by gastrointestinal disease die in the first week of life, and according to other authors, 50% of fatal cases were associated with bacterial intestinal infection, which in most cases was caused by pathogenic strains of *E. coli* (17). Research has shown that the causes of death and the risk factors for the seasonal change in the mortality pattern require further research, and the costs of global mortality have increased (in just three years) from 2.86 pecuniary units per pig marketed in 1996 to 5.22 in 1999, the adult mortality being much more pronounced in the autumn months, representing about two-thirds of this total cost (7, 11, 12).

After evaluating batches of pigs of different ages from the two types of breeding units and monitoring the costs of treatment per individual, it emerged that there may be situations when the 5.5% mortality threshold generally accepted by farmers was exceeded in type A units and implicitly, treatment and prevention costs were directly proportional to the variation of these limits. In the type A farms, at the date of the study, the mortality varied significantly, thus implicitly also the expenditure with the treatment and prevention of the diseases varied from 6 pecuniary units / individual, to 11.9 pecuniary units / individual. In type B farms the maximum allowable mortality limit has not been exceeded, but it can be seen that in these units the costs per treatment per animal have been higher. Thus, in the affluence phase of the unit, the costs of piglet treatments were around one pecuniary unit/animal, and in the finishing phases they even reached the value of 17 pecuniary units / animal.

Statistical significance of the results

The evaluations of the variables by types of units and on age categories determined us to analyze statistically, in general, the entire number of pigs in the breeding units visited, where we correlated the mortality rate with the investments made by farmers in the treatment and prophylaxis of pigs. Using the statistical interpretation program SPSS with the help of the correlation function we obtained the results shown in Table 6. By correlating these data on the impact of treatments performed on the evolution of farm mortality, we obtained statistically significant data and its value $p \leq 0.01$. This demonstrates that a correctly applied treatment is effective in maintaining a low mortality rate. The data obtained also showed that the increased frequency of diseases is the variable that can certainly change the results of the calculation of profitability in all pig units. Thus, we observed that at an incidence of 40 cases affected by a pathogen, the mortality rate was around 3.21% (Fig. 2), and the higher the incidence of diseases, the higher the mortality rate.

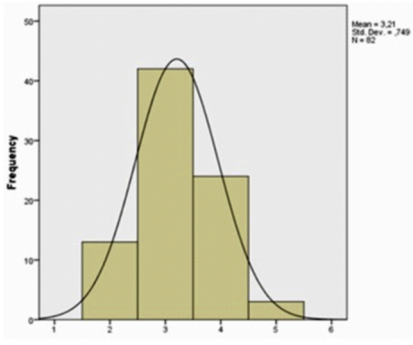

Fig. 2. Frequency of mortality rate

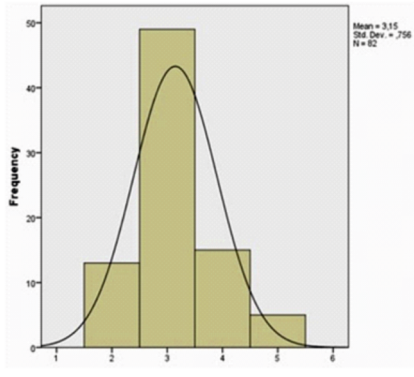

Fig. 3. Frequency of medication / animal head

The statistical analysis revealed that more than 40 treatments applied to pigs affected by a pathogen result in a cost of 3.15 pecuniary units per animal (Fig. 3).

As the frequency of treatments increases, they will involve high extra costs with medication. Our results are confirming that to eliminate all additional costs and into profit rise a rigorous approach of the biosecurity measures have to be implemented as soon as possible.

CONCLUSIONS

In type B units (of small capacity), the mortality rate was lower, compared to type A units (of large capacity). The mortality rate, both for type A and type B units, was higher in the adult swine category compared to the swine youth. The costs of preventing and treating animals on type B farms were higher than those on type A.

REFERENCES

1. *Anggelopoulosb S., Galanopoulosa K., Kamenidouc I., Mattas K.*, (2006), Assessing the effects of managerial and production practices on the efficiency of commercial pig farming. Agricultural systems, 88(2-3):125-141
2. *DeDecker J.M., Ellis M., Wolter B.F., Corrigan B.P., Curtis S.E., Hollis G.R.,* (2005), Effect of stocking rate on pig performance in a wean-to-finish production system. The Canadian Veterinary Journal, 85(1):1-5
3. *Edwards S.A., Baxter E.M.*, (2014), Chapter 11. Piglet mortality: causes and prevention, In: The gestating and lactating sow, (Ed.) C. Farmer, USA
4. *Gebhardt J.T, Tokach M.D, Dritz S.S, DeRouchey J.M, Woodworth J.C, Goodband R.D, Henry S.C.,* (2020), Postweaning mortality in commercial swine production. I: review of non-infectious contributing factors. Translational animal science, 4(2):462-484
5. *KilBride A.L., Mendl M., Statham P., Held S., Harris M., Cooper S., Green L.E.*, (2012), A cohort study of preweaning piglet mortality and farrowing accommodation on 112 commercial pig farms in England. Preventive veterinary medicine, 104(3-4):281-291
6. *Koketsu Y.,* (2000), Retrospective analysis of trends and production factors associated with sow mortality on swine-breeding farms in USA. Preventive veterinary medicine, 46(4):249-256
7. *Larriestra A.J., Maes D.G., Deen J., Morrison R.B.,* (2005), Mixed models applied to the study of variation of grower-finisher mortality and culling rates of a large swine production system. The Canadian vet. journal, 69(1):26-31
8. *Larriestra A.J., Wattanaphansak S., Neumann E.J., Bradford J., Morrison R.B., Deen J,* (2006), Pig characteristics associated with mortality and light exit weight for the nursery phase. The Canadian veterinary journal = La revue veterinaire canadienne, 47(6):560-566
9. *Losinger W.C., Bush E.J., Smith M.A., Corso B.A.*, (1998), An analysis of mortality in the grower / finisher phase of swine production in the Unites States. Preventive veterinary medicine, 33(1-4):121-145
10. *Losinger W.C., Bush E.J., Smith M.A., Corso B.A.,* (1998), Mortality attributed to respiratory problems among finisher pigs in the U.S. Preventive vet med, 37(1-4): 21-31
11. *Maes D., Larriestra A., Deen J., Morrison R.*, (2001), A retrospective study of mortality in grow-finish pigs in a multisite production system. Journal of swine health and production, 9(6):267-273
12. *Maes D.G.D., Duchateau L., Larriestra A., Deen J., Morrison R.B., Kruif A.,* (2004), Risk factors for mortality in grow-finishing pigs in Belgium. Journal of veterinary medicine. B, Infectious diseases and veterinary public health, 51(7):321-326
13. *Marchant J.N., Rudd A.R., Mendl M.T., Broom D.M., Meredith M.J., Corning S., Simmins P.H.* (2000), Timing and causes of piglet mortality in alternative and conventional farrowing systems. Veterinary record, 147(8):209-214
14. *Mehling S., Henao-Diaz A., Maurer J., Kluber E., Stika R., Rademacher C., Zimmerman J., Giménez-Lirola L., Wang C., Holtkamp D.J., Main R., Karriker L., Linhares D.C.L., Breuer M., Goodell C., Baum D.*, (2019), Mortality patterns in a commercial wean-to finish swine production system. *Veterinary sciences 6(2)*:49
15. *O'Reilly K., Harris M., Mendl M., Held S., Moinard C., Statham P., Marchant-Forde J.,* (2006), Factors associated with preweaning mortality on commercial pig farms in England and Wales. *The Vet. record,* 159(7):193-196
16. *Shankar B.P., Madhusudhan H.S., Harish D.B.,* (2009), Pre-weaning mortality in pig-causes and management. *Veterinary world,* 2(6):236-239
17. *Svendsen J., Bille N., Nielsen N.C., Larsen J.L., Riising H. J.*, (1975), Preweaning mortality in pigs. Diseases of the gastrointestinal tract in pigs. Nordisk vet, 27(2):85-101.
18. *Wilfart A., Montagne L., Simmins H., Noblet J., Van Milgen U.J.,* (2007), Effect of fibre content in the diet on the mean retention time in different segments of the digestive tract in growing pigs. *Livestock science,* 107(1-3):27-29.