

THE INFLUENCE OF TEMPERATURE FROM THE SHELTER ON THE CONVERSION OF FEED IN MEAT AT FATTY PIGS

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Abstract: *The food administration way has effects on its capitalization, the farm management having to adopt a certain behavior in ensuring the pigs need to achieve the planned performances in terms of maximum efficiency. The exploitation system, the density of the animals from the box, the microclimate/temperature can affect the quality of the carcass and the pork meet, because when the microclimate conditions are not ensured at the optimum parameters, adaptive stress occurs, with effects on production performance. Fattening pigs exploited in shelters with controlled temperatures achieve an average daily increase of $750,52 \pm 2,20$ grams with a consumption of $2,97 \pm 0,41$ kg of feed per kilogram of growth in weight. The differences were statistically significant $p \leq 0.05$ between the two lots, exploited at different temperatures, but the differences were not statistically significant for the specific consumption at a significance threshold of $p \geq 0.05$.*

Key words: *fatty pigs, intensive system, temperature, consumption*

INTRODUCTION

The achievement of quantitative and qualitative meat production, regardless of the exploitation technology, cannot be achieved, without ensuring the comfort requirements specific to each category of swine. The temperature, humidity, speed of air currents, from swine shelters, the so-called microclimate factors, must be ensured, according to the season, by means of installations, within optimum limits, for each age category, weight, according to the requirements of races and commercial hybrids that are exploited: (Table 1).

Table 1.

Optimum temperature and temperature limits depending by the category of swine

Item	optimum °C	desirable limits °C
Sowing sows	15,0-16,0	10,0-26,0
Sows with milk	15,0-16,0	10,0-21,0
Piglets	33,0- 34,0	32,0-38,0
Suckling piglets	26,0-27,0	23,0-29,0
Youth at the crèche	24,0-25,0	15,0-27,0
Fatty pigs	15,0-16,0	10,0-26,0

The profitability of swine exploitation in intensive-industrial systems is given by the nutritional level and the microclimate factors that are ensured in the shelters, their observance, resulting in growth gains with the deposition of muscle mass in the carcass and less fats, superior conversion indices of feed. By using commercial hybrids for high quality meat production at high growth rates, it is necessary to ensure in shelters special welfare conditions to reach the biological limits of the species, for example in fatty pigs, reaching the weight of 100-105 kg at 100-135 days, classified S carcasses were obtained with over 65% lean meat. [12, 13, 16, 19]

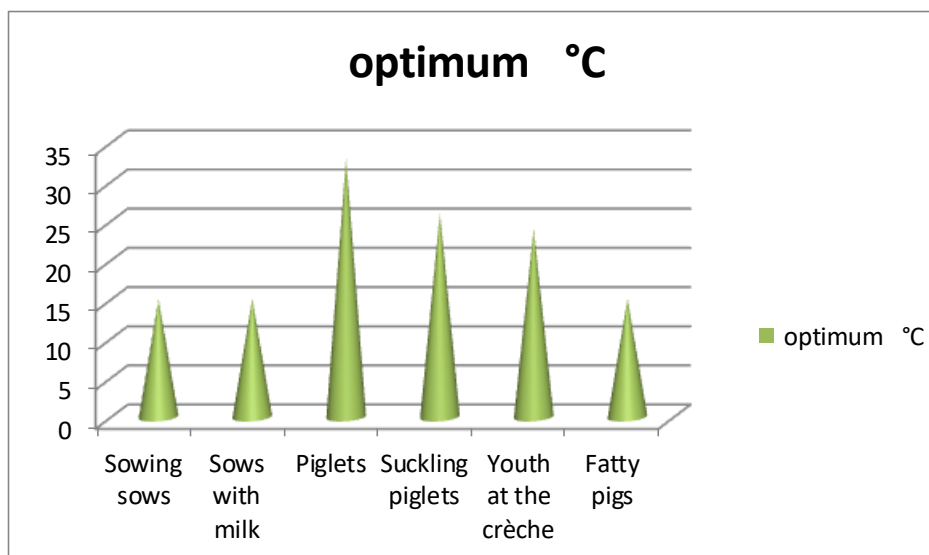


Figure 1. Optimum temperature depending by the swine age

The way of food administration influences its use by fatty pigs, regardless of the type of exploitation system, if the age of each age group is not ensured, the optimal conditions of microclimate. Farm management must adopt a certain behavior to ensure the need of the pigs to achieve the planned performance under the most efficient conditions. Normally or discreetly, in the form of meals, granulated, dry or wet, in 1 to 3 portions, it has influence on conversion, if it is balanced protein-vitamin-mineral, it is advisable to administer ad libitum if the temperature in the shelter can be kept within 15.0-15.5°C regardless of the season. The feeding level influences the conversion of feed and, implicitly, the performance obtained if the optimal temperature in the shelter is maintained at 15.0-15.5°C. In order to achieve the best production performance, the level of feeding imposed by the farm management will have the following objectives: [2, 4, 10, 17, 18, 21]

- for obtaining lean meat, the feed rate will be high, but the performance will be reduced to the biological value of the hybrid, the ability to convert the feed, requiring measures to improve the genetic value of the hybrid and to restrict feed consumption, for optimizing economic returns;

- to improve specific consumption, to achieve the best conversion indices, we recommend moderate feeding to achieve the optimal level of performance, taking management measures to improve consumption, implementing a low or very high feeding pattern. Feed conversion (specific consumption) is minimal in the case of a moderate feeding regime but increases when the feeding level is low or very high;

- in order to improve the daily average weight gain, we recommend a high level of nutrition to achieve maximum performance, maintaining the optimal shelf temperature of 15.0-15.5° C to achieve optimum consumption and feed conversion in the most efficient meat. The average daily average will be higher if the feed consumption is also high.

The level of feeding of fatty pigs influences feed conversion and production performance if an optimal temperature of 15.0-15.5°C is ensured in the shelter. [3,5,8,9,20] Higher temperatures force the swine to adjust by effort and adjust the body temperature, which is achieved by increasing feed and water consumption. At low temperatures, the performance of fattening pigs is reduced, and the quality of the carcass decreases due to the accumulation of fat, which is done with high feed consumption. During fattening, the swine are subjected to different temperature variations because they are exploited in different systems (intensive, semi intensive and extensive) and in the farms that maintain animals, the thermal conditions are not always constant.

Table 2.

Production performances at fatty pigs at the optimum temperature of 15.0-15.5°C

The objective	Level of feeding	Performance	Improvement measures
Lean meat	High	Decreases	Consumption restriction
Specific consumption	Moderate	Minimum	Feeding regime low or very high
Average daily gain	High	Maximum	Optimum consumption, best conversion index, at 15.0-15.5 °C

Even in shelters that provide an optimal temperature, due to either inadequate mechanical control of microclimate factors, or to variations in external environmental factors, disturbances may occur in achieving the average daily increases in fattening and increased feed conversion indices. [1, 6, 7, 11, 14, 15]

MATERIALS AND METHODS

In the achievement of this scientific approach, in order to determine the influence of the temperature from the shelter on the daily average increase in meat feed to fatty pigs, we carried out investigations on two lots of fattened pigs exploited semi-intensively in shelters with controlled and uncontrolled temperature to highlight the quality of meat obtained and the economic efficiency of the exploitation.

RESEARCH RESULTS

The shelters for the fattening of the pigs must be:

- compartmentalized, to maintain an appropriate microclimate;
- to enable a continuous flow of production;
- to ensure animal welfare;
- to meet the biological requirements of the species.

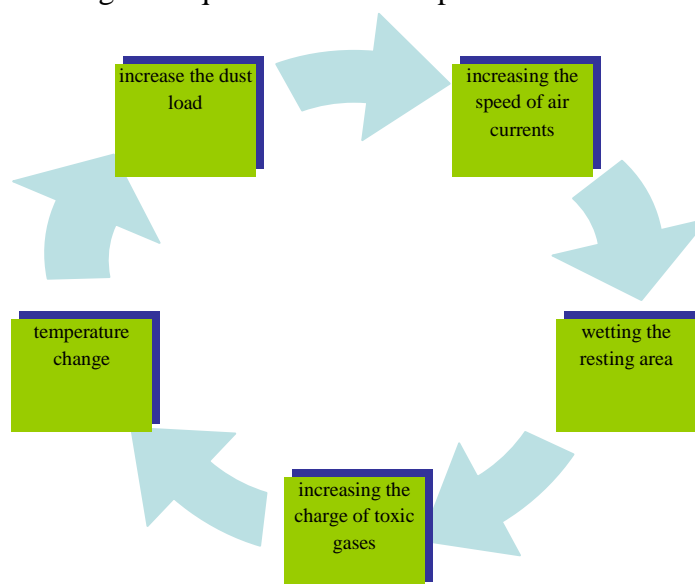


Figure 2. Changes of behavior at fatty pigs due to stress

Shelters for pigs fattened will ensure optimal maintenance conditions and have logistics for feed, watering, drainage, ensure optimal microclimate. The maintenance system, animal density, microclimate, temperature can affect the quality of the carcass and swine meat, because when microclimate elements are not secured to the optimum parameters, stress produces effects on production. Non-compliance with microclimate factors determines at swine lots:

- increase the dust load, causing agitation, changing resting areas, box dirt and respiratory tract irritation;
- increasing the speed of air currents, causing swelling of the swine and agglomeration in the darker areas of the box;
- temperature change, causes crowding of animals for heating or space alterations;
- wetting the resting area, causing alteration to rest and fodder, watering;
increasing the charge of toxic gases, causing agitation, irritation of mucous membranes and respiratory tract.

We recommend for the farmer, according to the financial resources, some methods to achieve performance, taking into account the degree of improvement of the biological material, the possibilities of purchasing the fodder and their quality, the feeding levels, the planned performances, the implemented farm management:

- rated diet in fatty pigs determines average daily gains with optimal conversion indices only at optimal ambient temperatures, corresponding to age and weight, and protein deposit in the carcass in large quantities in the first part of life;
- specific consumption does not increase if the optimal temperature in the shelter is ensured, the protein deposition remains superior to lipid deposition.
- swine of breeds unimproved, with low protein deposition in carcasses, subject to fattening in controlled temperature shelters (15.0-15.5°C), regardless of age or weight, and the conversion indices are high.

It is considered by the specialists in the field of breeding and exploitation of pigs for meat production that temperature is the factor, which exerts a strong influence on:

- fundamental biological processes;
- metabolic processes.

In the area of thermal neutrality, the energy expenditure is minimal, which characterizes the basic metabolism and when the temperature of the environment decreases, reaching the critical point, there is a rapid and intense increase of the energy metabolism, which is the immediate reaction to the defense against the cold. Growth and development, being two biological processes strictly dependent on metabolism, the optimal temperature that ensures maximum yields varies according to the weight, physiological and swine age categories. For these reasons, for example, the average daily gain of fatty pigs is lower, in cold seasons, with ambient temperatures being adjusted in shelters. Experiences by various authors show that commercial meat hybrids have average daily gains increased by 2-4 g at ambient temperatures of 15.0-17.0°C and lower at temperatures higher than 24.0-25.0°C. Although in intensive-industrial exploitation there are possibilities of temperature regulation in the shelters, for each category of swine an optimal temperature should be ensured at which the food is capitalized at the highest parameters. It is noted that the lower the temperature in the thermal comfort area is inappropriate, so the use of food is not economic, by increasing the specific consumption and decreasing the gain in weight.

In order to determine the optimal temperature and how it influences the performance of the swine exploited in a professional farm, we have studied 2 lots of commercial hybrids:

- lot A of 100 pig heads, exploited at ambient temperature of 13-14°C, in shelters provided with a paddock and without heating source, having at the beginning of the experiment 30.5 ± 1.43 kg and age 70 ± 2 days .
- lot B lot of 100 pig heads exploited at a temperature of 15.0-17.0°C, in shelters provided with a paddock, but the animals had no access outside, with possibility of heating the shelter, 40% of the surface of the box and 60% grid, the average weight of 30.7 ± 2.07 kg and age 70 ± 2 days.

During the experiment, 95 days were followed for the following production indicators:

- growth gain in weight;
- specific consumption;
- outflows from the flock;
- how to organize the box.
- the thickness of the bacon layer on the carcasses;
- the percentage of meat in the carcass;
- meat-fat ratio;

The daily average gain in lot A over 95 days of fattening was 750.52 ± 2.20 grams, with a consumption of 2.97 ± 0.41 kg of feed per kg of weight gain.

The daily average gain in lot B over the entire fattening period was 784.21 ± 3.40 grams with a consumption of 2.62 ± 0.27 kg of feed, to achieve one kilogram of weight gain.

We can see that the controlled temperature of 15.0-17.0°C from the shelter of B-group pigs has positively influenced the growth of weight gain that is in the opposite correlation with the specific consumption. Thanks to the optimum temperature, the pigs did not use the energy for thermoregulation, but they used it efficiently for meat production. Due to the good conditions ensured during the fattening period, the pigs have kept their resting area clean, no changes in behavior or altercations or outflows have occurred.

In lot A, due to the lack of logistics to regulate microclimate factors, slight changes in behavior were observed during the fattening period, by agglomeration of the animals when the temperature was at the lower limit of 13°C and wetting of the reserved space for rest. The results obtained during the fattening period were good, but inferior to those obtained in the swine exploited in a controlled environment. Exits from the flock by necessity of slaughter due to accidents were reduced by 3 heads, and by death 1 head.

In table 3 are presented the results obtained during the fattening period, the average daily increase and the specific consumption, made according to the temperature from the shelter.

Table 3.

Average daily gain and specific consumption based on indoor temperature

Lot	Average daily gain (grams)	Specific consumption (kg feed/kg gain)
A	750,52±2,20Aa	2,97±0,41 a
B	784,21±3,40ca	2,62±0,27 a

t test, A-a $p \leq 0,001$, A-b $p \leq 0,01$, A-c $p \leq 0,05$, a-a $p \geq 0,05$

By comparing the results obtained under different ambient temperature conditions, we can see the following:

- the differences are statistically significant, $p \leq 0.05$ between the two groups, regarding the average daily increase;

- differences are not statistically significant, for specific consumption, $p \geq 0.05$;

Since lot B has achieved the highest average daily increase, with a low specific consumption, under optimal temperature conditions, we can say that:

- ensuring and controlling the optimum temperature, according to age and weight, is the key to success in gaining performance in swine fattening;

- balanced ratios contribute to highlighting the hereditary data of commercial hybrids at optimal parameters;

- avoiding heat stress contributes to low energy consumption for thermoregulation;

- investments in shelters, biological material and logistics are amortized in a short time by the production gains achieved.

At slaughtering and carcasses obtaining the thickness of the fat layer determined at the two lots, on the carcasses obtained by slaughtering, fattened at different temperatures, the following measurements were made:

- cervical, vertebrae 6-7;
- chest, vertebrae 19-20;
- lumbar in 3 points (anterior extremity of the gluteus medius muscle, middle of the gluteus medius muscle, the posterior part of the muscle);
- abdominal, in the right of the sternum, navel and flank.

The average of the lumbar measurements in lot A was 1.71 ± 0.22 cm, the abdominal 1.33 ± 0.14 cm and the dorsal 1.75 ± 0.13 cm, and for group B the mean of the were 1.33 ± 0.12 cm lumbar, 1.20 ± 0.37 cm abdominal and 1.30 ± 0.32 dorsal (Table 4).

From the analysis of the obtained results, we find that in fat swine exploited at low temperatures the conversion of the feed is inefficient, the fat is deposited in the carcasses, the thickness of the layer of bacon in the measured points is higher in the group A, the muscular mass is reduced due to the consumption energy for thermoregulation but also as a protection against cold.

Table 4.

The thickness of the fat layer in carcasses from lots A and B

Lot	Average lumbar measurements (cm)	Average abdominal measurements (cm)	Average dorsal measurements (cm)
A	1,71±0,22 ca	1,33±0,14 a	1,75±0,13 ca
B	1,33±0,37 Aa	1,20±0,37 a	1,30±0,22 Aa

t test, A-a $p \leq 0,001$, A-b $p \leq 0,01$, A-c $p \leq 0,05$, a-a $p \geq 0,05$

Analyzing statistically, test t, the results of the measurements regarding the thickness of the fat layer on the carcasses of lots A and B, we find that in lot A all measurements on the thickness of the bacon indicate higher values. The statistical analysis highlights that:

- at a significance threshold of $p \leq 0.05$ the differences are significant between group A and group B in terms of thickness of the fat layer from the lumbar region. The best results were obtained in group B fattened under controlled microclimate conditions at optimal temperature, fat deposits in the lumbar region being lower;

- at a significance threshold of $p \geq 0.05$ with respect to the average of the measurements in the abdominal area the differences were not statistically significant;

- the differences were distinctly significant, for a reference threshold of $p \leq 0.05$ with respect to the thickness of the dorsal fat layer, in group A the average of the measurements was 1.75 ± 0.13 versus 1.30 ± 0.22 in lot B. It results that at low temperatures fatty pigs make energy reserves compared to those fattened at optimal temperatures that do not need energy for thermoregulation and put muscle tissue in the carcasses at economic yields because they are provides conditions to perform through farm management implemented.

The ratio of meat: fat was in lots A and B as shown in table 5 and figure 2. The percentage of lean meat in lot A was 53.20% and in lot B 55.47%.

Table 5.

Ratio meat: fat in lots A and B

Lot	Lean meat (%)	Fat (%)	Bones (%)	Meat/fat ratio
A	53,20	31,70	15,10	1:1,53
B	55,47	29,63	14,90	1:1,20
Differences ± lot B	+2,27	-2,07	-0,20	

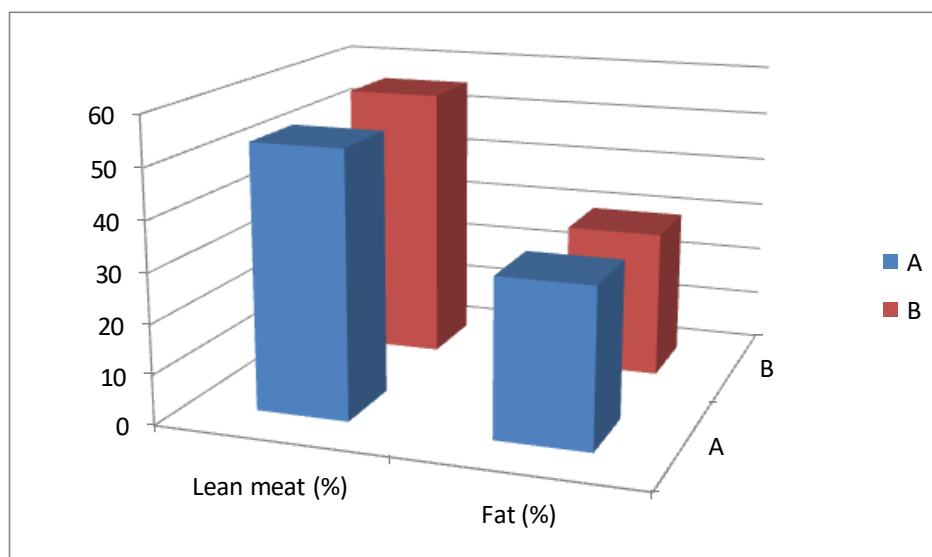


Figure 3. Fat and lean meat in lots A and B

Fatty pigs exploited at the optimum temperature, produce carcasses with a high proportion of lean meat in turn exploitation at low temperatures determines the deposition of higher quantities of fat in the carcasses due to the adaptability of the swine at the operating conditions they forming the deposits of fat necessary for thermoregulation.

Based on these biological adaptation mechanisms, to the high or low operating temperature conditions, we propose some managerial measures to reduce energy consumption for thermoregulation:

- at high temperatures.
 - cooling the surfaces of the speakers;
 - cooling of the animal skin by direct water spraying;
 - air cooling at the intake to the shelter to speed up breathing;
 - setting the temperature in the shelter with the fans;
 - control of microclimate factors

No insuring optimal temperatures and others factors of comfort, in order to achieve production at the highest parameters contributes to changing the mechanisms of adaptation, in boxes of fatty pigs installing the discomfort and appearance of stereotypes that are manifested by:

- searching for dark and wet areas;
- high water consumption;
- accelerating breathing;
- waste of fodder;
- decreasing food consumption;
- changes in thyroid function;
- interference between individuals;
- changing the hierarchy of the group;
- unjustified movements inside the box.

At 13-14°C, in fatty pigs it is found that:

- the number of breaths per minute is reduced;
- external body temperature decreases;
- fatty pigs are agitated;
- animals are piling up;
- the box is not organized;

- the boxes are dirty and damp.

At the optimum temperature for fattening of 15.0-17.0°C, with the control of the microclimate factors it was found that:

- the hierarchy is installed in the box;
- animals are quiet;
- energy is not consumed for thermoregulation;
- the boxes are well organized;
- the boxes are 98% clean.

CONCLUSIONS

The controlled temperature of 15.0-17.0°C from the pigs of the B group positively influenced the growth of weight gain that is in the opposite correlation with specific consumption. Thanks to the optimum temperature, the pigs did not use the energy for thermoregulation, but they used it efficiently for meat production. Due to the good conditions ensured during the fattening period, the pigs have kept their resting area clean, no changes in behavior or altercations or outflows have occurred.

It is noted that fatty pigs, exploited at optimum temperatures, produce carcasses with high lean meat, instead, exploitation at low temperatures leads to higher fat deposition in the carcasses, due to the good adaptability of the pigs to the operating conditions, and they form fat deposits required for thermoregulation. We note that the failure to ensure optimal temperatures and other comfort factors to achieve production at the highest parameters contributes to the modification of the adaptation mechanisms in the fatty pigs booths creating discomfort and the emergence of stereotypes.

REFERENCES

- [1]. **BEJAN C., PETROMAN I., IANCU T., PETROMAN CORNELIA, BOGOȘEL D.F., MARIN DIANA, CIOLAC RAMONA, DUMITRESCU CARMEN, CHIRILĂ COSMINA**, 2014, Values of some reproduction indicators in grazed sows depending on artificial insemination number and intervals, *Journal of Biotechnology*, Vol. 185, pag. S52;
- [2]. **CHIRILĂ COSMINA, PETROMAN I., PETROMAN CORNELIA, MARIN DIANA, DUMITRESCU CARMEN, BEJAN C., MOMIR B.**, 2014, Study regarding births on sows maintained in different types of stalls, *Journal of Biotechnology*, Vol. 185, pag. S52;
- [3]. **DANCIU G., PANICI G., PETROMAN CORNELIA, MARIN DIANA, DUMITRESCU CARMEN, PETROMAN I.**, 2018, The role of farm management in reducing the interval from weaning piglets to conception, *Journal of Biotechnology*, vol 280, pages S37;
- [4]. **HARRIS D. L.**, 2000, *Multi-site Pig Production*, Iowa State University Press;
- [5]. **HEBER LOREDANA, PETROMAN CORNELIA, PETROMAN I., BĂLAN IOANA, MARIN DIANA, IVAȘCU GABRIELA, POPOVICI C.**, 2011, Pork and carcasses quality in swine exploited in family farms, *Scientific Papers Animal Science and Biotechnologies*, vol 43, pg. 406-408;
- [6]. **HERMANSEN J. E., AARESTRUP LARSEN VIVI, ANDERSEN BENT HINDRUP**, 2002, *Development of organic pig production systems*, Perspectives in Pig Science. Loughborough: University of Nottingham;
- [7]. **ENGEL J. K., BLACKWELL R. D., MINIARD P. W.**, 1990, *Consumer Behaviour*, Sixth Edition, The Dryden Press;
- [8]. **KATSUMATA M., KAJI Y., SAITOH, M.**, 1996, Growth and carcass fatness responses of finishing pigs to dietary fat supplementation at a high ambient temperature. *Animal Science* 62: 591-598;

- [9]. **MARIN S., PETROMAN CORNELIA, ALBU SIMONA, BABA F., MILIN ANDA, MARIN DIANA**, 2017, Study regarding methods of diversification of the agro-food products offer, *Journal of Biotechnology*, Vol. 256, pag. S73;
- [10]. **MARIN DIANA, IENOVAN DANIELA, PETROMAN I., PETROMAN CORNELIA, CSAHOLCZI A., CIOLAC RAMONA**, (2017), Study regarding the consumption of meat from self-consumption in punction of it's provenance, *Journal of Biotechnology*, Vol. 256, pag. S74;
- [11]. **MARIN DIANA, PĂCALĂ N., PETROMAN I., PETROMAN CORNELIA, UNTARU RAMONA, CIOLAC RAMONA**, 2012, Influence of age and weight at slaughter over meat quality in conditions of optimum ambient temperature, *Lucrări științifice Management Agricol, Seria 1*, vol. XIV (4), Facultatea de Management Agricol, Timișoara, pg. 453-458;
- [12]. **PETROMAN CORNELIA, PETROMAN I., MARIN DIANA, CIOLAC RAMONA, VĂDUVA LOREDANA**, 2013, Frequency of consumption of meat and meat products in Timis county, *Lucrări Științifice Zootehnie și vol. 46 (1)*;
- [13]. **PETROMAN CORNELIA**, 2013, Frequency of consumption of meat and meat products in Timis county, *Scientific Papers Animal Science and Biotechnologies*, volumul 46(2);
- [14]. **PETROMAN I.**, 2007, *Managementul sistemelor de creștere și exploatare a animalelor*, Editura Eurostampa;
- [15]. **PETROMAN I., CULEA C., NICOLAE M., PETROMAN CORNELIA**, 2002, *Creșterea porcinelor*, Editura Mirton, Timișoara;
- [16]. **PETROMAN I., UNTARU RAMONA CALIOPI, MARIN DIANA**, 2013, Breeding season influence of sows gestation loss, *Journal of Food Agriculture and Environment*, Vol. 11, issue 2, pag. 305-307;
- [17]. **PETROMAN I., UNTARU RAMONA CALIOPI, PETROMAN CORNELIA, ORBOI MANUELA DORA, BĂNEȘ A., MARIN DIANA, BĂLAN IOANA, NEGRUT V.**, (2011), The influence of differentiated feeding during the early gestation status on sows prolificacy and stillborns, *Journal of Food Agriculture and Environment*, Vol. 9, issue 2, pag. 223-224, part 1;
- [18]. **ROMANIAN PORK PATRONATE** - Informative Bulletin, no. 15-32;
- [19]. **RISTEA I., BOLOCAN RODICA, PETROMAN CORNELIA, IANCU T., MATIN DIANA, PETROMAN I.**, 2018, Implementing measures for the safety of products obtained in agrotourist farms, *Journal of Biotechnology*, Vol. 280, pag. S37-S38;
- [20]. **VĂDUVA LOREDANA**, 2013, The influence of endogenous and exogenous factors on meat quality of pigs, *Scientific Papers Animal Science and Biotechnologies*, vol. 46, issue 1, pages 404-406;
- [21]. **VĂDUVA LOREDANA**, 2013, The influence of operating system on food and water consumption of fat pigs, *Scientific Papers Animal Science and Biotechnologies*, vol. 46, issue 2, pages 428-430;