The Bioproductive Effect of Thermic Stress at Mangalica Pigs

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Abstract
The study aimed to establish the effect of thermal stress on the productive performance of Mangalica breed. The animals were raised in alternative systems and exposed to 30-36°C and 8-11°C, respectively. The pigs had free access to standard, isoprotein and isocalory diets, with 13.5% crude protein (CP) and 3100 kcal/kg metabolizable energy. Feed intake was measured on a daily basis. The energy-protein balance was calculated on the basis of comparative slaughter made at the beginning and end of the experiment. The metabolizable energy (MEc) was estimated by chemical analysis (feed and excreta) using mathematical modelling and the Whittemore's formula. The efficiency of energy utilization for protein synthesis was 0.48 at heat stress and 0.55 at cold stress; for fat retention was 0.52 and 0.77, respectively.

Keywords: bioproductive effect, Mangalica, thermal stress

1. Introduction

Mangalica is a breed with a valuable genetic background which can be used in the current context of organic livestock, considering the natural resistance and adaptation to growing conditions in intensive, extensive and alternative systems [1].
The environmental factors have major influence on productive performances and feed efficiency. The negative implications of long-term exposure are often obvious in the critical production stages, as they are threatening and negatively impact the animal's welfare [2].
In particular context of ecophysiology, the environmental factors have major influence on productive performances, energy metabolism and feed use efficiency. [3].
The studies aimed a comparative study concerning the bioproductive effect of thermal stress at Mangalica pigs.

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2. Materials and methods

The experiments were conducted on Mangalica (M) pigs, raised in alternative system.
The animals were exposed to 30-36°C and 8-11°C, respectively. The initial weight of pigs was 101.3 kg at heat stress and 100.5 kg at cold stress.
The pigs had free access to water and to standard, isoprotein and isocalory diets, with 13.5% crude protein (CP), 4.9% lysine and 3100 kcal/kg metabolizable energy. Feed intake was measured on a daily basis.
The feed and excreta samples were analyzed according the Weende scheme. The crude protein was determined by Tecator – Kyeltec Auto Analyze. The ether extract was determined by Soxtec System HT, starch by the polarimetric method and sugar by Bertrand's method.
The fat thickness was measured by the stiletto method.
The digestibility coefficients for the nutritive substances were established as a result of 2 specific experiences, five days each.

The gross energy was calculated using standard equations. The digestible energy and digestible protein were determined by the specific experiments, when there recorded ingesta and excreta. The energetic and protein balance were calculated using mathematical modelling and the metabolizable energy (MEc) was calculated using Whittemore's formula [4]:

$$MEc=DE–(Eu+dE+6.8\ BFM+1.4\ S)$$

where: MEc=corrected metabolizable energy; DE=digestible energy; Eu=energy urine=7.2 DP, DP=deaminated protein, g, dE=deaminated energy=4.9 (DP–Pm) ; Pm=protein for maintenance, g (estimated by mathematical modeling) ; BFM=bacterial fermentable matter, g=(DCF+NDS)–(St+S) ; DCF=digestible crude fiber, g ; NDS=non-nitrate digestible substances, g ; St=starch, g ; S=sugar, g

Data were statistically analyzed by ANOVA method.

3. Results and discussion

The productive results are presented in Table 1.

Table 1. The productive results of pigs exposed at thermic stress

Specification	Heat stress	Cold stress
Initial weight, kg	101.3	100.5
Final live weight, kg	108.7	109.3
Daily weight gain, g	324.1	385.4
Feed intake, kg/day	3.57	5.87
Fat thickness, mm	27.7	67.8

The average daily weight gain was 324.1 g at heat stress and 385.4 g at cold stress. Compared with the neutral temperature results [5], the daily weight gain decreased with 25.5% at heat stress and 11.5% at cold stress. This parameter was significantly influenced by environmental temperature, but it was concluded that the exposure to cold temperatures was better tolerated by Mangalica breed, than the heat stress.

The compound feed intake was 3.57 kg at heat stress and 4.57 kg at cold stress. The results were lower by 21.9% and higher by 28.4%, respectively, compared with neutral temperature results [5]. Because the pigs regulate their feed intake according to the environmental temperature, this parameter was significant influenced.

The fat thickness was 27.7 mm at heat stress and 67.8 mm at cold stress. At neutral temperature, the fat thickness was 36.3 mm, the current results being lower by 23.7% and higher by 86.7%, respectively. These results are an adaptive response to thermal stress.

The data concerning the coefficients of diet digestibility are presented in Table 2.

Table 2. Coefficients of digestibility (%)

Specification	M	LW
Organic matter OM	86.77	88.25
Crude protein CP	90.62	90.87
Ether extract	80.67	81.14
Digestible energy (DE)	88.36	87.52

In terms of digestibility coefficients, no differences were found between the two thermal regimes.

The energy balance data is presented in Table 3.

Table 3. Energy balance (MJ/ $G^{0.75}$)

Specification	Heat stress	Cold stress
EMc	945	1973
Epr/ EMc	0.48	0.55
Elr/ EMc	0.52	0.77

The values obtained for the metabolizable energy corrected (MEc) were 945 MJ/$G^{0.75}$ at heat stress and 1973 MJ/$G^{0.75}$ at cold stress. The metabolizable energy utilization for protein synthesis was 0.48, respectively 0.55. At thermo neutral temperature, the literature shows that the energy efficiency ranged from 0.60 to 0.75, for early breeds [6], like Large White and Landrace. At Mangalica, in same conditions, the efficiency was 0.53, because is a late race and metabolism is different from that of improved breeds. The current studies have shown that the protein efficiency was not influenced by the environmental temperature.

The metabolizable energy utilization for fat retention was 0.52, respectively 0.77, being significant influenced by the environmental temperature.

4. Conclusions

The environmental temperatures influenced significant the productive performances and the efficiency utilization of energy for protein synthesis and fat retention.

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References

1. Ratky, J.P., Toth, I. Egerszegi, P. Sarlos, N., Manabe, K.P., Brussow, Multifunctional aspects of Mangalica breeding. Proceeding of the 5th Vietnamese - Hungarian International Conference on „Animal Production and Aquaculture for Sustainable farming” Can Tho University, Can Tho Vietnam, 2007, pp.42-44
2. Andronie, I.C., Andronie, V., Parvu, M., Radu, A., Behaviour of pregnant sows according to the housing system, Bulletin USAMV Veterinary Medicine, 2010, 67 (1), 12-16
3. Andronie, V., Bogdan, A.T., Pârvu, M., Andronie, I.C., Simion, V., Bercaru, N., Sistemul de cazare şi influenta sa asupra bunăstării scroafelor gestante, Revista Romana de Medicina Veterinara, 2010, 20(4), pp 23-34
4. Whittemore, C. and Kiriazakis, I., Whittemore’s Science and Practice of Pig Production, Third Edition, 2006, pp 379-
5. Pârvu, Monica, Bogdan, A.T., Andronie, Ioana Cristina, Amfim, Adriana, Aspects of Energy Metabolism in Mangalitsa Pigs Exposed at Thermic Neutral Temperature, Scientific Papers: Animal Science and Biotechnologies, 2011, 44 (2), 180-182
6. Pârvu, Monica, Andronie, Ioana C., Simion, Violeta, Zugravu, Corina, Berghes, Carmen, Amfim, Adriana, Energy Efficiency Of The Diets At The Fattening Pigs Exposed At Heat Stress, Bulletin USAMV Animal Science and Biotechnologies, 2010, 67 (1-2), 296-299.