Aspects of Energy Metabolism in Mangalitsa Pigs Exposed at Thermic Neutral Temperature

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Abstract
The studies aimed the energy metabolism determination in Mangalitsa pigs exposed at thermic neutral temperature, compared to Large White pigs. The experimental period was between 80 and 100 kg liveweight. The animals 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 metabolizable energy utilization efficiency was 0.61 at Large White and 0.53 at Mangalitsa.

Keywords: energy metabolism Mangalitsa pigs .

1. Introduction

Mangalitsa is one of the most popular breeds of pigs in Europe, because meat has superior properties, such as taste, marbling and low cholesterol content. The natural resistance and adaptability established the rise of this breed in alternative and intensive conditions.
The determination of energy metabolism is a relevant stage in assessing the efficiency of feed conversion to animal production.
The environmental factors have major influence on productive performances, energy metabolism and feed use efficiency. For example, exposure of Large White fattening pigs at heat stress by high temperature lowers the average daily gain with 23% [1]. 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]. The climate conditions have a major role in expressing the genetic potential of races and the metabolizable energy utilization efficiency. To assess the changes caused by environmental factors, it is necessary to know the normal aspects of energy metabolism in fattening pigs, depending on race.
The studies aimed the determination of energy metabolism in Mangalitsa pigs exposed at thermic neutral temperature, compared with Large White pigs.

2. Materials and methods

The experiments were conducted on each of 22 Mangalitsa (M) and Large White (LW) pigs, raised in intensive system. The initial average weight was 80 kg. The animals were assigned to two groups, exposed at 20°C ± 1°C. The relative humidity was 72%. The pigs were housed in air-controlled rooms.
The experimented was ended when the animals reached 100 kg body weight.
The animals had free access to water and to standard, isoprotein and isocalory diets, with 13.5% crude protein (CP), 4.9% lysine and 3100

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kcal/kg metabolizable energy. Feed intake was measured on a daily basis.

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 digestibility coefficients for the nutritive substances were established as a result of 2 specific experiences, seven 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 the method of comparative slaughtering and mathematical modelling. The metabolizable energy (MEc) was calculated using Whittemore's formula [3]:

$$MEc = DE - (Eu + dE + 6.8\ BFM + 1.4\ S)$$

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

The productive performances data were ANOVA statistically processed.

3. Results and discussion

In Table 1 presents data on the growth and carcass performances of two breeds.

Table 1. The growth and carcass performances

Specification	LW	M
Initial weight, kg	80.2	80.6
Final live weight, kg	100.5	100.2
Experimental period, d	27	45
Average daily gain, g	751.8	435.5
Feed intake, kg, kg	3.32	4.57
Fat thickness, mm	12.7	36.3

At Large White the 100 kg weight was achieved after 27 days, while at Mangalitsa this weight was obtained after 45 days. Because Mangalitsa is a late race, the 100 kg weight was achieved 18 days later, the differences being significant ($p \leq 0.05$).

The average daily weight gain was 751.8 g at LW and 435.5 g at Mangalitsa, with 42% less than LW. The differences were very significant ($p \leq 0.01$). These results are consistent with the physiological peculiarities of Mangalitsa, in literature mentioning that the weight of 140-180 kg is achieved at the age of 12-15 months, ensuring an average daily weight of 450-500 g.

The compound feed intake was 3.32 kg at LW and 4.57 kg at Mangalitsa, 37.6% more than LW. Because Mangalitsa is a rustic breed, it is characterized by high specific consumption, even if the diet is made up of compound feed. The literature says that, when the diet consists of corn, feed intake is 5.2 kg [42]. The dry matter intake was 2.89 kg at LW and 3.95 kg at Mangalitsa, the differences being significant ($p \leq 0.05$).

The fat thickness was 12.7 mm at LW and 36.3 mm at Malgalitsa, the differences being very significant ($p \leq 0.01$). Based on specific experiments, it was obtained the following coefficients (Table 2): organic matter (OM) 87.76% (LW) and 88.03% (M); crude protein (CP – apparent digestibility) 90.43% (LW) and 91.06% (M); energy 89.11% (LW) and 88.85% (M). The breed did not influence significantly the coefficients of diet digestibility.

Table 2. Coefficients of diet digestibility (%)

Specification	LW	M
Organic matter OM	87.76	88.03
Crude protein CP	90.43	91.06
Ether extract	81.26	80.88
Digestible energy (DE)	89.11	88.85

The protein balance data is presented in table 3.

Table 3. Protein balance (g/ $G^{0.75}$)

Specification	LW	M
Crude protein intake (CP)	13.44	18.50
Digestible crude protein	12.15	16.10
Protein accessible (PA)	6.31	8.77
Protein retained (Pr)	4.35	5.31
Deaminated protein (DP)	7.80	10.79

Concerning the protein retained, the values obtained were 4.35 g/ $G^{0.75}$ at LW and 5.31 g/ $G^{0.75}$ at Mangalitsa. It was noted that the estimated value for Mangalitsa is greater with 22%, the differences being significant ($p \leq 0.05$).
The energy balance data is presented in table 4.

Table 4. Energy balance (MJ/ $G^{0.75}$)

Specification	LW	M
GE	1486	2045
DE	1324	1817
Eu	63	79
dE	36	46
MEc	1225	1692
MEPr	748	897
MEPr / MEc,	0.61	0.53

For LW, the energy balance shows values of 1486 MJ/$G^{0.75}$ gross energy (GE) and 1324 MJ/$G^{0.75}$ digestible energy (DE).
For Mangalitsa, the energy balance shows values of 2045 MJ/$G^{0.75}$ gross energy (GE) and 1817 KJ/$G^{0.75}$ digestible energy (DE).
For swine, a number of researches suggest that DE is preferable in energy requirements, because this energy is easily and precisely determinated [34].
The values obtained for the metabolizable energy corected (MEc) were 1225 MJ/$G^{0.75}$ at LW and 1692 MJ/$G^{0.75}$ at Mangalitsa. The energy retained (MEPr) was calculated by mathematical modeling, the estimated values were 748 MJ/$G^{0.75}$ at LW and 897 MJ/$G^{0.75}$ at Mangalitsa. The metabolizable energy utilization efficiency was 0.61, respectively 0.53. At thermo neutral temperature, the literature shows that the energy efficiency ranged from 0.60 to 0.75, for early breeds [1]. Mangalitsa. At Mangalitsa, the efficiency is lower, because is a late race and metabolism is different from that of improved breeds.

4. Conclusions

The compound feed intake was significantly influenced by breed, being higher with 37.6% at Mangalitsa.
The breed did not influence significantly the coefficients of diet digestibility, differences between Large White and Mangalitsa were insignificant.
The metabolizable energy utilization efficiency was 0.61 at Large White and 0.53 at Mangalitsa breed.

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References

1. Parvu, M., Andronie, I. C., Simion, V., Zugravu, C., Berghes, C., Amfim, A., 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
2. Andronie V., Bogdan, A.T., Pârvu, M., Andronie, I., Simion, V., Bercaru, N., Sistemul de cazare şi influenta sa asupra bunăstării scroafelor gestante, *Revista* Romana de Medicina Veterinara, 2010, 20, 4, 23-34
3. Whittemore, C., and Kiriazakis, I., Whittemore’s Science and Practice of Pig Production, Third Edition, 2006, pp 379-383
4. Noblet, J., Karege, C., Dubois, S., and van Milgen, J., Metabolic utilization of energy and maintenance requirements in growing pigs: effects of sex and genotype, J. Anim. Sci. 1999, 77, 208-1216