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Effects of body weight on some blood plasma parameters of pigs from the Alentejano breed

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SUMMARY – This work has evaluated the influence of body weight (BW) on some plasma parameters of Alentejano pigs. Thirty castrated Alentejano pigs (~35 kg BW) were allocated in individual pens and fed a commercial diet (0.85 x *ad libitum*). The pigs were slaughtered in groups (n=5) with an average BW of 42.2, 70.9, 80.2, 90.1, 100.5, and 110.2 kg. Plasma samples obtained at slaughter were analysed. Glucose and triacylglycerol levels decreased (P≤0.05) with increasing BW, suggesting that during growth Alentejano pigs increased the use of glucose and triacylglycerols as energy and substrate for fat synthesis and deposition. Total cholesterol increased (P≤0.05) with BW, due to an increase (P≤0.05) in the low-density lipoprotein (LDL) cholesterol level, following the trends reported in ageing mammals. The Alentejano pig, with a high lipogenic activity, could be a valuable model for studies of the cholesterol metabolism.

Keywords: Alentejano pig, body weight, blood plasma parameters, glucose, lipids, lipoproteins.

RESUME – *"Effets du poids corporel sur quelques paramètres plasmatiques chez le porc Alentejano". Ce travail a évalué l'influence du poids corporel sur quelques paramètres plasmatiques chez le porc Alentejano. Trente porcs Alentejano (~35 kg) castrés ont été placés en cages individuelles et nourris avec un régime commercial (0,85 x* ad libitum*). Les porcs ont été abattus en groupes (n=5) à un poids moyen de 42,2, 70,9, 80,2, 90,1, 100,5 et 110,2 kg. Des échantillons de plasma obtenus à l'abattage ont été analysés. La concentration en glucose et triglycérides a diminué (P≤0,05) avec l'augmentation du poids, en suggérant que les porcs Alentejano avaient augmenté l'emploi de ces composés comme source d'énergie et comme substrat pour la synthèse des tissus adipeux. Le cholestérol total a augmenté (P≤0,05) avec le poids, par l'augmentation du cholestérol des LDL, suivant la tendance observée chez les mammifères vieillissants. Le porc Alentejano, avec une capacité adipogénique élevée, pourrait être un modèle valable pour des études du métabolisme du cholestérol.*

Mots-clés : *Porc Alentejano, poids corporel, paramètres plasmatiques, glucose, lipides, lipoprotéines.*

Introduction

The Alentejano pig is an autochthonous breed reared in the south of Portugal. This breed is different from the highly selected lean European breeds, presenting slower growth rates and higher lipogenic activity at an early stage of development (Neves *et al*., 1996). Traditionally reared outdoors and eating mainly grass and acorns during their finishing period, the Alentejano pig is nowadays increasingly reared in semi-extensive systems and fattened with commercial diets to provide fresh meat for human consumption.

Data concerning the blood parameters of the Alentejano pig are scarce. Although a few parameters have been measured in Alentejano piglets (Freire *et al*., 1996 and 1998), there is no information regarding the concentration of the most common blood parameters during the growing-finishing period of the Alentejano pig. Such information is required to provide an adequate frame of reference for further physiological work with this breed. Some blood parameters may also be used to predict disease resistance, health status, meat quality, or performance traits (Lingaas *et al*., 1992). Blood cholesterol levels, for instance, were positively correlated with fat deposition and considered to give a more valuable indication of body composition than performance data alone (Taylor *et al*., 1992).

The present study aimed to investigate the evolution of several blood plasma parameters of sexually neutralised male and female Alentejano pigs during the growing-finishing period, as a contribution to the knowledge of the physiology of this breed.

Materials and methods

Chemicals, animals, housing, diet and feeding

Chemicals of the highest purity were bought from Sigma (St Louis, MO, USA). Enzymic kits were purchased from Roche Diagnostics (Mannheim, Germany).

A total of thirty pigs from the Alentejano breed (11 males and 19 females) were purchased at Herdade da Casa Branca (Pavia, Portugal). After weaning (60 d), these pigs were transferred to Herdade da Mitra, Universidade de Évora (Évora, Portugal) and castrated. All the pigs were identified by transponders, surgically implanted behind the ear. At ~35 kg of body weight (BW), the Alentejano pigs were allocated in open-air individual pens (1 x 2 m) with individual feeding and free access to water throughout the experimental period. The pigs were fed a commercial diet (Proibérico 2, Provimi, Alverca, Portugal) providing about 150 g/kg crude protein, 30 g/kg crude fat (with ~60% of C18:1 and C18:2 fatty acids), and 3100 kcal DE. The diet was offered in a single daily meal (~9.00 h) at 0.85 x *ad libitum*, to prevent excessive carcass adiposity (Freitas *et al*., 1996).

Experimental design and sampling procedures

The Alentejano pigs were weekly weighed before their morning meal, and each experimental group daily feed allowance was adjusted for the following week. The pigs were divided into 6 groups (n=5 each) and after a 24-h fast they were killed by electronarcosis and bleeding at the Sousel municipal slaughterhouse (Sousel, Portugal). At slaughter, the experimental groups averaged 42.2 (W40), 70.9 (W70), 80.2 (W80), 90.1 (W90), 100.5 (W100) and 110.2 kg BW (W110).

Blood samples were taken during exsanguinations and blood plasma was obtained by centrifugation (20 min at 4℃ and 1500 g) and stored at -80℃ until analysis.

Plasma and lipoprotein analyses

Plasma levels of total protein were determined by the Lowry method (Lowry *et al*., 1951), using bovine serum albumin as a standard. The plasma levels of glucose, triacylglycerols, phospholipids, and total cholesterol were determined by enzymic kits, in an automatic analyser (Hitachi 917, Hitachi, Tokyo, Japan). The low-density lipoprotein (LDL) and high-density lipoprotein (HDL) cholesterol levels were determined by direct enzymic kits, as described above.

Calculations and data analyses

Statistical analyses were performed by a one-way ANOVA with the statistical software Statview 5.0 (SAS Institute). Differences were considered significant when $P \leq 0.05$. A linear regression model (Statview) was used to analyse the Pearson correlation coefficients (r) between BW and plasma parameters.

Results

All the pigs remained in good health throughout the experimental period and no diet refusals were detected.

The increasing BW of Alentejano pigs did not affect their plasma total protein and phospholipid levels (Figs 1 and 4). On the other hand, it significantly decreased ($P \leq 0.05$) the plasma glucose and triacylglycerol levels (Figs 2 and 3). BW was negatively correlated with these plasma parameters ($P \leq 0.009$, r = -0.48 and $P \leq 0.001$, r = -0.56, respectively).

During growth, there was a significant increase ($P \leq 0.05$) in plasma total cholesterol (Fig. 5), due to a significant increase ($P \leq 0.05$) in the LDL cholesterol fraction (Fig. 6). BW was significantly correlated with plasma total and LDL cholesterol levels ($P \leq 0.001$, r = 0.63 and 0.78, respectively). As to the levels of HDL cholesterol, they were not significantly affected by BW (W40: 1.11 ± 0.08; W70: 1.12 ± 0.06; W80: 1.12 ± 0.07; W90: 1.14 ± 0.09; W100: 1.19 ± 0.04; and W110: 1.18 ± 0.10 mmol/l).

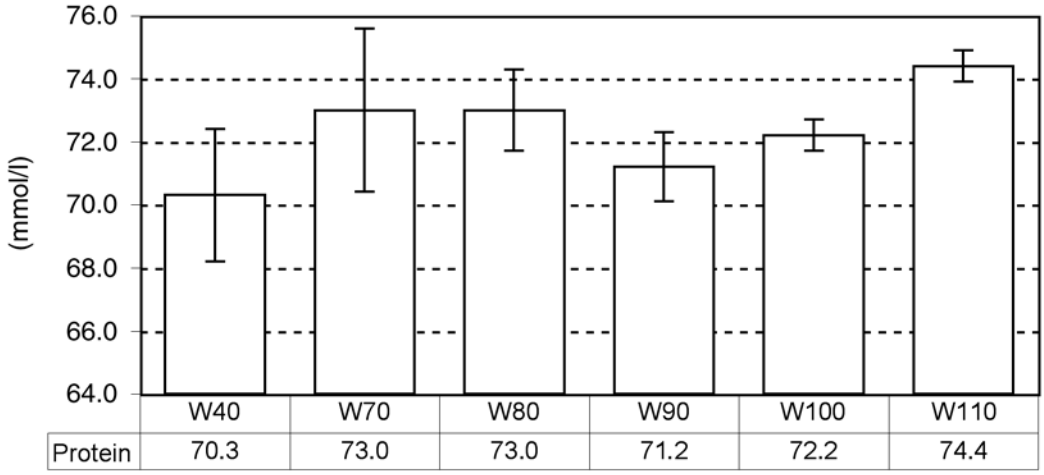


Fig. 1. Influence of BW on the plasma total protein levels of Alentejano pigs.

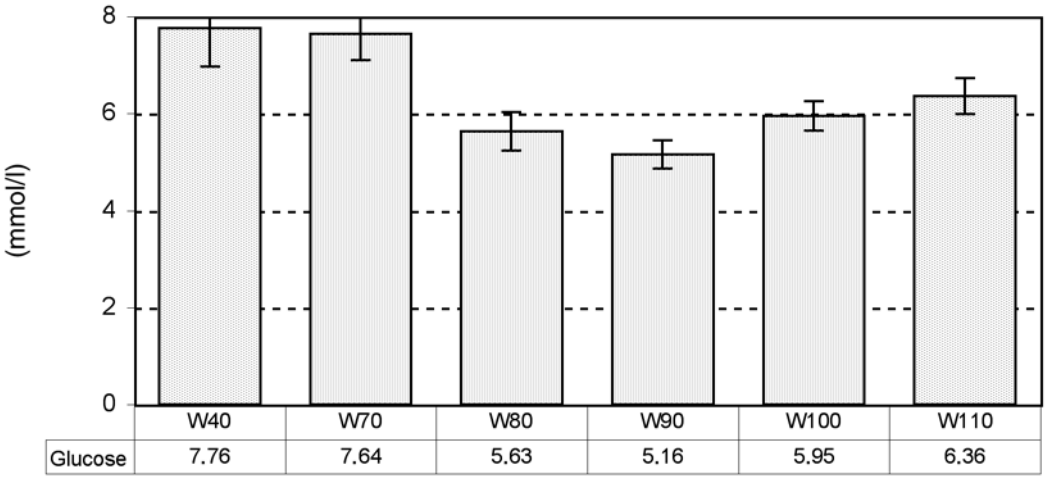


Fig. 2. Influence of BW on the plasma glucose levels of Alentejano pigs.

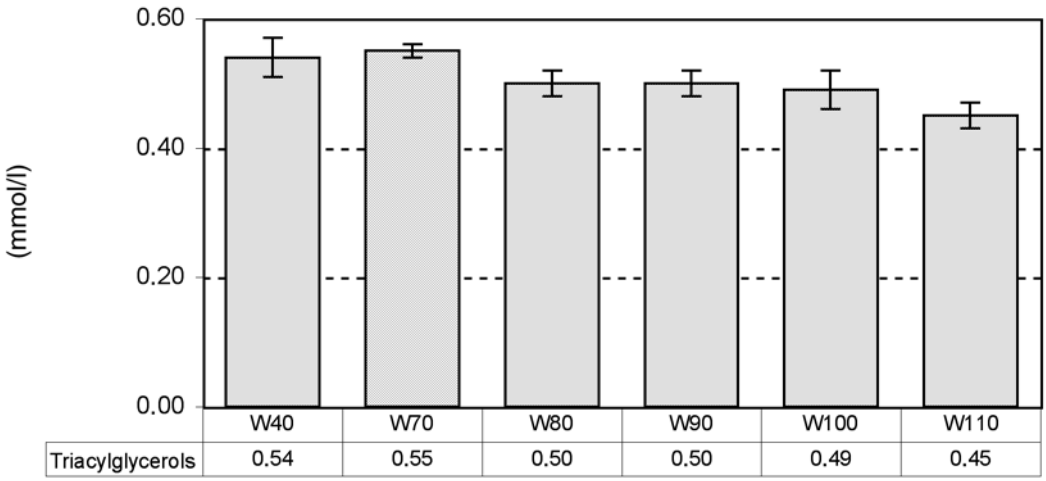
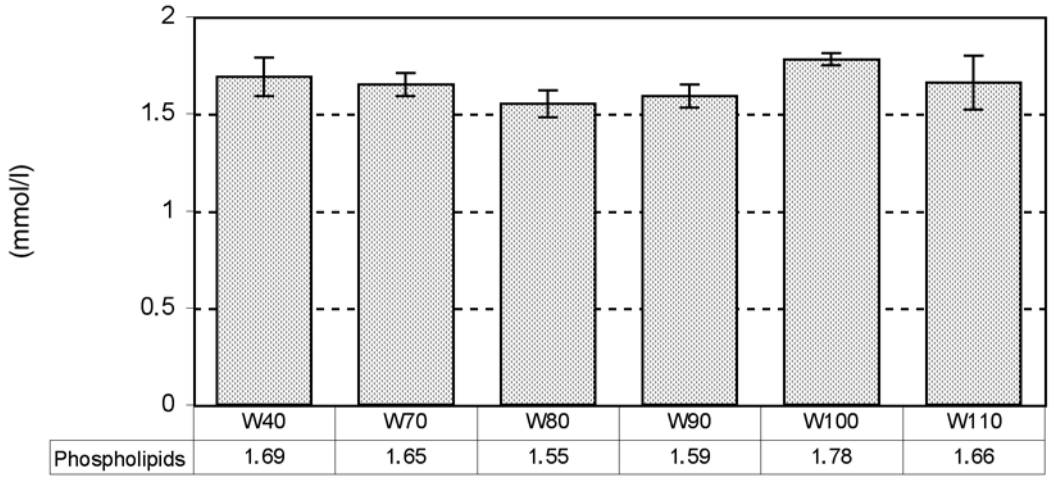
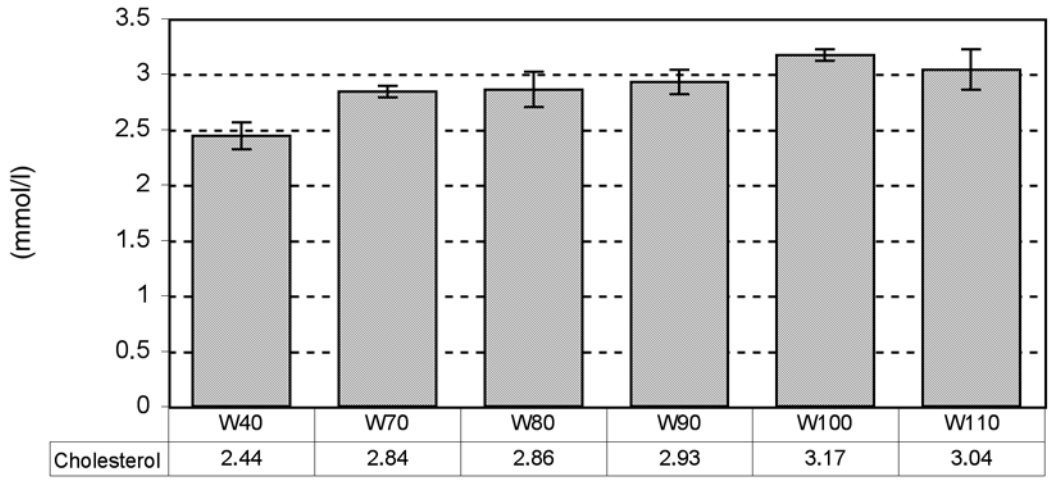


Fig. 3. Influence of BW on the plasma triacylglycerol levels of Alentejano pigs.



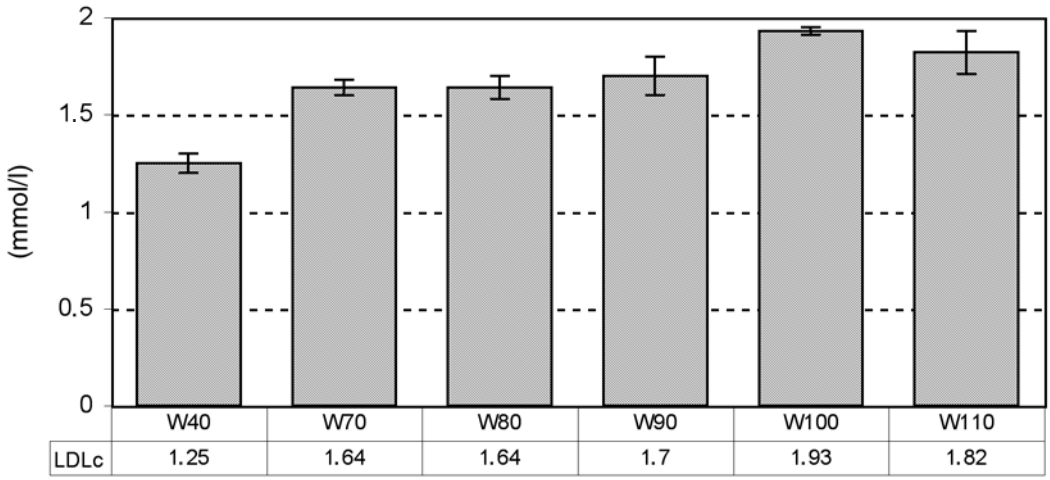
	W40	W70	W80	W90	W100	W110
Phospholipids	1.69	1.65	1.55	1.59	1.78	1.66

Fig. 4. Influence of BW on the plasma phospholipid levels of Alentejano pigs.



	W40	W70	W80	W90	W100	W110
Cholesterol	2.44	2.84	2.86	2.93	3.17	3.04

Fig. 5. Influence of BW on the plasma total cholesterol levels of Alentejano pigs.



	W40	W70	W80	W90	W100	W110
LDLc	1.25	1.64	1.64	1.7	1.93	1.82

Fig. 6. nfluence of BW on the plasma LDL cholesterol levels of Alentejano pigs.

Discussion

Levels of biochemical blood parameters are regulated by complex genetical and physiological mechanisms (Lingaas *et al*., 1992). Even so, all the plasma non-lipid parameters observed in the Alentejano pigs between 40 and 110 kg BW were within the normal physiological range of growing-finishing pigs of lean European breeds (Swenson, 1993).

In pigs, about 80% of the lipids are synthesized from dietary glucose, the main physiological precursor of fatty acids (Henry, 1977), and the growth period is characterised by a high incorporation of lipids in the cell membranes and stored in the adipocytes (Henry, 1977; Martincic *et al*., 1984). In our study, the Alentejano pigs presented a significant decrease of plasma glucose and triacylglycerol levels from W40 to W110. Such observations suggest that during growth this breed increased the use of glucose and triacylglycerols as energy and substrate for fat synthesis and deposition. These results are in agreement with the fact that the Alentejano pig is known for its high capacity to synthesize body fat (Neves *et al*., 1996) and were previously observed in obese pigs (Pond *et al*., 1988).

Cholesterol has vital functions as a component of the cell membrane of mammals and as a precursor of bile acids, several important steroid hormones, and vitamin D3 (Krieger, 1999). These functions are often overshadowed by the association of plasma total and LDL cholesterol levels to atherosclerotic diseases. The effects of BW and age on the cholesterolemia of growing-finishing pigs are not yet clearly understood and may also depend on diet, genetic and environmental factors. On the other hand, there is little information concerning the concentrations of plasma total cholesterol and LDL and HDL cholesterol in the Alentejano breed. To our knowledge, these are the first determinations of such parameters reported for the growing-finishing period of the Alentejano pig. In general terms, these results are in agreement with the metabolic changes observed in ageing mammals (including humans), which lead to a net accretion of the body lipid and cholesterol fraction (Kritchevsky, 1980; Mahley *et al*., 1981). Our results also show that in the Alentejano pig, cholesterol is mainly transported by the LDL fraction, as in humans. Although these preliminary results need to be confirmed in larger populations, they suggest that the Alentejano pig, with a high lipogenic activity, could be a valuable model for studies of the cholesterol metabolism.

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