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CHARACTERISATION OF PIGS' TESTICLES

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I. INTRODUCTION

As the production of male pigs increases, either intact males or immunocastrates (Improvac®), a 'new' by-product emerges in a bigger volume than before in pig production – namely testicles. This calls for innovative use, e.g. in biotechnology, and thus in the production of protein powder that can enter the food chain. An improved utilisation of the male pig will also contribute to the overall sustainability in the industry. Today, the skin and fat surrounding the testicles as well as the glandula bulbourethralis and the testicles are removed at the slaughter line and end up as animal by-products in biofuel. By means of enzymatic hydrolysis, several different types of tissue can be included in a comprehensive process to produce a protein hydrolysate that can be used as food-grade protein and as an ingredient in pet food. To achieve the best possible hydrolysis, it is essential to know the mass of the testicles from the average male carcass and the composition of the raw testicles in order to select the most appropriate enzyme mixture and hydrolysis process (pH, time, temperature).

The aim of the project was to determine the chemical composition of the testicles and fat tissue for further use and to investigate the weight variation in testicles from intact males and immunocastrates ready for slaughter.

II. MATERIALS AND METHODS

Study 1. At the slaughter line, the testicles, along with the surrounding fat and skin, were removed prior to the opening of the carcass. Both fat and testicles were collected from 14 male pigs, sourced from 9 different farms. The two tissue types were analysed separately for their chemical composition: total protein using Kjeltec 8400/8420, fat content using Soxtec™ 8000, collagen content using Hydroxyproline (colorimetric determination) and androstenone and skatole using LDTD-MS/MS [1].

Study 2. Testicles from 381 male pigs (intact (IM) or immunocastrates (IC)) originating from 15 different farms were selected at the slaughter line, and the epididymis and surrounding fat were trimmed off. Both testicles were weighed, and the length and circumference were measured. Information on hot carcass weight and meat percentage (measured using AutoFOM III™; Frontmatec Group, Smoerum, Denmark) was also collected for all carcasses. Statistical analysis was performed in RStudio (version 2024.12.1+563). Effect of group (IM or IC) on slaughter weight, meat content, total testicle weight, average length and circumference was analysed using a nested ANOVA with a linear mixed-effects model (nlme package):

$$Y_{ij} = \mu + \alpha_i + b_j + E_{ij},\ \ b_j \sim N(0, \sigma_b^2),\ \ E_{ij} \sim N(0, \sigma_E^2)$$

Y represents the response variable, μ is the overall mean, α is the fixed effect of group (IM, IC), b is the random effect of farm, and E is the residual error.

III. RESULTS AND DISCUSSION

Study 1. Skatole was only found in the fat fraction and was detected in 5 out of the 14 male pigs, while the rest were below the detection limit. Androstenone was not detected in 4 of the testicle samples, whereas androstenone was present in the fat tissue of all 14 samples. The chemical composition is shown in Table 1.

Table 1 – Chemical composition of testicles and fat tissue (n=14).

Component	Water	Fat	Protein	Collagen	Skatole	Androstenone
Testicle	83.00 ± 0.79	2.37 ± 0.67	12.98 ± 0.65	2.49 ± 0.51	0	0.17 ± 0.16
Fat tissue	59.83 ± 7.94	25.73 ± 8.76	13.57 ± 1.88	4.09 ± 1.30	0.08 ± 0.14	1.31 ± 1.24

The results showed that the trimmed testicles can advantageously be used as raw material in enzymatic hydrolysis, as they are free from skatole and contain only low levels of androstenone.

Study 2. The correlation between testicle weight, length (R^2=0.71) and circumference (R^2=0.89) is high. The effect of farm on testicle size was significant within the group of IC, and there was only a small difference between farms using IM, Table 2 and Figure 1b.

Table 2 – Slaughter data and testicle size from intact (IM) or immunocastrates (IC).

	IM (n=240)	IC (n=141)	Significance
Slaughter weight (kg)	91.5 ± 8.7	94.2 ± 7.6	ns
Meat content (pct)	60.8 ± 2.1	60.7 ± 2.7	ns
Total weight of both testicles (gram)	519 ± 119	421 ± 163	P<=0.05
Average length (cm)	11.4 ± 1.1	10.7 ± 1.8	ns
Average circumference (cm)	19.1 ± 1.6	17.3 ± 2.6	P<=0.01

Škrlep et al. [2] found a large effect of immunocastration (Improvac®) on the weight and size of the testicles. However, their study only included pigs from a research station in a more controlled environment, including timing of the 2nd vaccination that was distributed 5 weeks before slaughter.

Fàbrega et al. [3] found no effect of housing system or delivery strategy. In the same study [3], a correlation between testicle weight and slaughter weight was found. This was not found in the present study, which may be due to the slaughter weight – although normally distributed – not varying as much as in [3], where two groups with a weight difference of 20 kg were compared, or that only IM was included in [3].

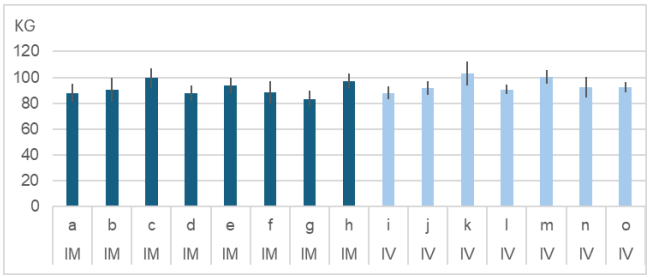


Figure 1a. Slaughter weight*

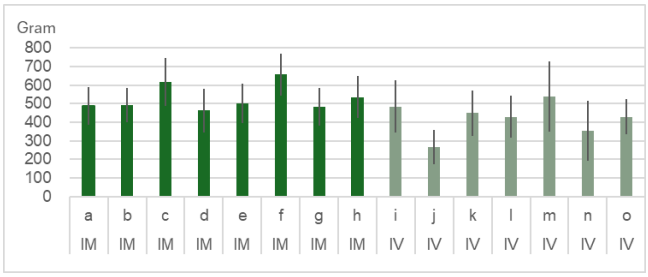


Figure 1b. Testicle weight*

* a, b, c…o represents at least 10 pigs from one farm. The black line is the standard deviation.

Immunocastration (Improvac®) has no significant influence on the slaughter weight and meat content, but there was some effect of farms (Figure 1a). Immunocastration (Improvac®) reduced the weight of the testicles (Figure 1b) with a large effect of the individual farm (Figure 1b).

IV. CONCLUSION

In the production of male pigs without the use of surgical castration, a 'new' raw material – in a larger volume than before – is to be handled at the slaughterhouses. Although immunocastration (Improvac®) reduces the total weight of the testicles by at least 20%, the cleaned testicles still amount to approximately 400 grams and >500 g from IM. The chemical composition of the testicles makes them interesting to utilise together with other tissue (by-products) e.g. in enzymatic hydrolysis for better utilisation of the protein. Furthermore, the low content of skatole and androstenone means there is no risk of off-flavour.

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