

EFFECT OF RECOMBINANT PORCINE SOMATOTROPIN ON CHEMICAL AND HISTOLOGICAL CHARACTERISTICS OF GROWING PIGS

KUHN G., ENDER K., REHFELDT CH., NÜRNBERG K.

Research Institute for the Biology of Farm Animals, DUMMERSTORF, Germany

S-IVA.19

SUMMARY

Fifty-seven barrows (East German Landrace) were randomly allocated to one of three treatment groups: 0, 2 or 4 mg rpST. Injections were administered daily for 75 days during the finishing period. The day after slaughter, left carcass half was divided into wholesale cuts. Each wholesale cut was completely separated into lean meat, external fat and bone. Water, protein, lipid and ash contents were determined within the following eight fractions (without bone): head, breast/belly, shoulder/foot, loin, ham/foot, external fat, internal fat, edible internal organs. Additionally, the fatty acid composition (backfat), muscle fibre diameter (m. long. dorsi) and fat cell diameter (backfat) were determined. The fraction breast/belly showed the strongest changes in the chemical composition. It approached to the composition of the lean cuts. In depot fat tissues (external and internal fat) the relative increases in water, protein and ash contents were significant. However, the relative decrease in lipid content seemed to be physiologically limited compared to other fractions. The proportion of polyunsaturated fatty acids of backfat, especially the linoleic acid was increased in a dose dependent manner. Within the lean cuts the cuts with higher fat percentages showed stronger changes in water, protein and lipid contents than cuts with lower fat percentages. The histological investigations demonstrated the relationships between the changed chemical composition of the carcass cuts and the enhanced hypertrophy of skeletal muscle fibres and reduced hypertrophy of fat cells.

Introduction

Daily administration of recombinant porcine somatotropin (rpST) in growing pigs elicits dose - dependently marked reduction in carcass lipid deposition and increase in protein deposition (ENDER et al. 1990; THIEL et al. 1993). Although the general changes in carcass composition are well documented, little is known about the intensity of rpST-effects on individual body fractions. Investigations of this subject enlarge the knowledge about the differences between the individual body regions conditioned by different growth. Furthermore, they give informations about the possible use of the individual body parts for fresh meat consumption or processing, provided the rpST-application would be approved. In this experiment the dose-response effects of rpST-administration on the chemical composition of the edible whole body and its individual body fractions were determined. Investigations of muscle fibre and fat cell diameters were included to examine relations to histological changes in the tissues.

Material and Methods

Fifty-seven purebred Landrace (East Germany) barrows were used in the experiment. The pigs were randomly allocated to one of three treatment groups: 0, 2 or 4 mg rpST (pST; Pitman-Moore, Terra Haute, IN). The special experimental conditions are described by Poppe et al. (1990). After slaughtering of the pigs the left carcass half was divided into wholesale cuts. Each wholesale cut was completely separated into lean meat (incl. intermusc. fat), external fat and bone. Following eight fractions (without bone) were made to determine water, protein, lipid and ash content: head, breast/belly, shoulder/foot, loin, ham/foot, external fat, internal fat, edible internal organs. The nutrient content of the edible whole body was calculated from the nutrient content of the individual fractions. Techniques for determination of fatty acid composition and muscle fibre and fat cell diameters are described by REHFELDT and ENDER (1993) and REHFELDT et al. (1994). Data were subjected to analyses of variance, using the GLM-procedure of SAS (LSM-method) with the effect of rpST-dose. Carcass weight was included as a covariate.

Results and Discussion

The chemical composition of the edible whole body changed in all characteristics significantly (Table 1). The water content increased by 7.68 % (rel. +16 %) in the first treatment group and by 10.85 % (rel. +22 %) in the second treatment group. This effect is in relation to marked reduction of lipid content by 10.94 % (rel. -29 %) and 14.81 % (rel. -40 %), resp. Simultaneously, the contents of protein and ash were increased by 3.11 % and 0.16 %, resp. (rel. +23 and 25 %, resp.). The water : protein - relation changed from 3.67 to 3.42.

The chemical composition of the individual fractions of edible whole body is represented in Table 2 and Table 3. The rpST-application caused dose-dependently a marked repartition in all fractions. However, the intensity of repartition was different in the individual fractions. The cut breast/belly is the body fraction with the strongest changes in all characteristics of the chemical composition (water, protein, lipid, ash). Moreover, the relative reduction of lipid content by - 31 % in the first treatment group and - 42 % in the second treatment group is very high and equivalent to relative changes of the lipid content in cutlet. The water : protein - relation decreased from 3.45 to 3.30. Taken together with the reduced lipid content this decrease might improve the nutritional value of the breast/belly. These observations correspond with the results of genetical influence after which the use of lean breeds results in qualitative improvement of the cut breast/belly especially (BRANSCHIED u.a. 1990; KUHN u.a. 1993).

The backfat differs from other fractions by marked relative increases in the contents of water, protein and ash (up to + 58 % for water, + 70 % for protein, + 95 % for ash). These significant increases might be a result of the higher concentration in connection with the reduced lipid content. The protein is mainly included in connective tissue to care for tissue stability. The increased water content and decreased lipid content have unfavourable effects on the fat consistency. Changes in the fatty acid composition, induced by rpST, in favour of unsaturated fatty acids have the same unfavourable effect (Figure 1). The reduction of lipid content down to 80 % of the control only seems to be caused by physiological reasons. The reduction of lipid is accompanied with reduced hypertrophy of fat cells. After 5 weeks rpST - application a stagnation of fat cell growth was observed (Figure 2). This suggests that lipogenesis in the subcutaneous backfat was inhibited, because fat cell growth is based upon the deposition of lipids.

The reduction of lipid content in internal fat was more limited compared to backfat. The water : protein - relation is high and increased further by the rpST-influence.

In relation to depot fats (external and internal fat) the meat cuts (ham/foot, shoulder/foot and loin) had stronger relative decreases of lipid content. An additional particularity within these fractions was that cuts with higher fat percentages (loin) showed higher increases in water and protein content and higher decreases in lipid content than cuts with lower fat percentages (ham/foot). In this way similarity exists to rpST-application in lean and obese pigs after which obese pigs showed stronger reactions in the lipid reduction than lean pigs (KANIS et al. 1990; KLINDT et al. 1992). The higher contents of water, protein and ash in meat cuts were connected with enhanced hypertrophy of muscle fibres. This is suggested on the basis of mean fibre diameter of m. long. dorsi measured at the beginning of treatment and after five weeks and ten weeks of treatment (Figure 3).

The edible internal organs have a relatively constant composition. The reduction of lipid content by 1.50 % (rel. -21 %) was equalized by higher water content. The water : protein - relation remained constant.

Conclusions

Changes in the chemical composition of the individual body fractions of edible whole body, induced by rpST, are not proportionally. The quality of the cut breast/belly for fresh meat consumption is highly improved. The processing quality of the external fat is deteriorated.

References

- BRANSCHIED, W.; FEWSON, D.; SACK, E.: Untersuchungen über den Fleischanteil der wertvollen Teilstücke und der Schlachthälfte bei marktgängigen Schweineherkünften. *Fleischwirtsch.* 70 (1990) 3, 333-336
- ENDER, K.; LIEBERENZ, M.; NÜRNBERG, K.; POPPE, S.: Einfluß der Applikation von porcinem Somatotropin (pST). 2. Mitt.: Schlachtkörperzusammensetzung und Fleischqualität. *Arch. Tierz.* 33 (1990) 6, 471-479

- KANIS, E.; NIEUWHOF, G. J.; de GREEF, K. H.; van der HEL, W.; VERSTEGEN, M. W. A.; HUISMAN, J.; van der WAL, P.: Effect of recombinant porcine somatotropin on growth and carcass quality in growing pigs : interactions with genotype, gender and slaughter weight. *J. Anim. Sci.* 68 (1990), 1193-1200
- KLINDT, J.; BUONOMO, F. C.; YEN J. T.: Administration of porcine somatotropin by sustained-release implant: growth and endocrine responses in genetically lean and obese barrows and gilts. *J. Anim. Sci.* 70 (1992), 3721-3733
- KUHN, G.; KÜCHENMEISTER, U.; ENDER, K.: Untersuchungen zur geweblichen Zusammensetzung des Schlachtkörpers und einzelner Teilstücke bei verschiedenen Schweineherkünften. *Arch. Tierz.* 36 (1993) 1, 49-65
- POPPE, S.; PFLUGHAUPT, G.; HACKL, W.; ENDER, K.: Einfluß der Applikation von porcinem Somatotropin (pST). 1. Mitt.: Mastleistung. *Arch. Tierz.* 33 (1990) 5, 435-442
- REHFELDT, CH.; ENDER, K.: Skeletal muscle cellularity and histochemistry in response to porcine somatotropin in finishing pigs. *Meat Sci.* 34 (1993), 107-118
- REHFELDT, CH.; NÜRNBERG, K.; ENDER, K.: Effects of exogenous porcine somatotropin on the development of fat cells and fatty acid composition in backfat of live finishing pigs. *Meat Sci.* 36 (1994), 321-331
- THIEL, L. F.; BEERMANN, D. H.; KRICK, B. J.; BOYD, R. D.: Dose-dependent effects of exogenous porcine somatotropin on the yield, distribution, and proximate composition of carcass tissues in growing pigs. *J. Anim. Sci.* 71 (1993), 827-835