ID COMPOSITION OF CARCASS TISSUE FROM TRANSGENIC PIGS

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SUMMARY

Total lipid, fatty acid profiles and cholesterol content of whole carcass ground tissue e compared for transgenic (T) pigs expressing a bovine growth hormone gene and control (C) gs. Pigs were slaughtered at five different weights: 14, 28, 48, 68 and 92 kg. Total rcass fat followed a different pattern of deposition in T-pigs than in C-pigs. Carcass fat reased with increasing live weight in T-pigs compared to a continuous increase (carcass) in C-pigs. A dilution effect on fatty acids was observed in T-pigs with increasing live ght, whereas, fatty acid concentrations increased in C-pigs. Cholesterol content was not fferent between T- and C-pigs at any of the slaughter weights.

INTRODUCTION

The technology for introducing recombinant genes into laboratory animals has been ilable only since 1980. Gene transfer techniques have evolved from the first successful e transfer experiments carried out in mice in 1980 (GORDON et al, 1980). Success in mice mpted similar experiments in farm animals. HAMMER et al (1985) described the first oduction of transgenic livestock by pronuclear injection. Most of the gene transfer periments carried out with farm animals during the late 1980s attempted to manipulate owth and related production characteristics such as feed efficiency. However, little is own regarding body/carcass composition and lipid composition of transgenic livestock. erefore, the purpose of this study was to determine what effect the introduction of combinant bovine growth hormone (rbGH) gene into pigs has on lipid and carcass composition.

MATERIALS AND METHODS

Animals and Feed. Fifty-two transgenic and control pigs were G2 generation descendants of nsgenic founder 31-04 and G3 and G4 generation descendants of transgenic founder 37-06. e founders of these two transgenic lines were produced by microinjection of fertilized ova th a MT-bGH fusion gene (PURSEL et al, 1989). Subsequent generations were produced by rtificial insemination of non-transgenic crossbred females with fresh or frozen epididymal permatozoa recovered from transgenic boars after euthanasia. Presence of the transgene was tablished by hybridization of dot blots of DNA from tail biopsies (HAMMER et al, 1985). pression of the transgene was established by radioimmunoassay of plasma collected at 1 week age or older using a bGH radioimmunoassay that did not measure pGH (MILLER et al, 1989). asma bGH concentrations were >1000 ng/ml in transgenic pigs of the 31-04 line and 25 to 200 g/ml in transgenic pigs of the 37-06 line. Pigs were weaned at 4 to 8 weeks of age and fed libitum a corn-soybean meal diet containing 18% crude protein, supplemented with .25% ysine. Pigs were slaughtered at five different live weights: 14, 28, 48, 68, and 92 kg.

Experimental. The left side of each intact carcass (skin and hair included) was ground in whole-carcass grinder and random samples of ground tissue were collected. Tissue samples

were analyzed for proximate-chemical composition, fatty acid composition, and cholesterol content.

Isolation of Lipids. The FOLCH et al (1957) procedure was employed to obtain lipid extracts of each sample. Preparation and isolation procedures were previously described by SOLOMON et al (1990). Fatty acids were converted into methyl ester derivatives prior to GLC analysis. Methylation and preparation of samples for GLC analysis were previously described (SOLOMON et al, 1990). Cholesterol was converted to a trimethylsilyl ether derivative. The derivatizing procedure and sample preparation were previously described (SOLOMON et al, 1990).

Data Analysis. Data were analyzed by the analysis of variance technique (SAS, 1985) to determine the significance of variation between transgenic and control pigs at the five different weight groups for a 2 x 5 factorial arrangement which included treatment x weight group interactions. When significant ($P<.05$) main effects for weight groups were detected, Duncans Multiple Range Test was used to separate means.

RESULTS AND DISCUSSION

Carcass fat deposition followed a different pattern for T-pigs compared to C-pigs (Table 1). Total carcass lipid increased (190%) in the C-pigs from 14 to 92 kg live wt, whereas in the T-pigs, total carcass lipid increased (32%) only from 14 to 48 kg live weight and then decreased (45%) from 48 to 92 kg (overall 27% decrease from 14 to 92 kg). At 14 kg slaughter weight, carcasses from T-pigs contained 38% less fat than C-pigs. At 28 kg, T-pigs had 36% less total carcass fat; at 48 kg, 48% less total carcass fat; at 68 kg, 78% less total carcass fat, and at 92 kg, T-pigs contained 85% less carcass fat than C-pigs. Total cholesterol content of the ground carcass tissue was not different between T- and C-pigs at any of the designated weights; however, with increasing live weight (14 to 92 kg), cholesterol content decreased for both C- and T-pigs (23% C-pigs; 28% T-pigs).

Carcass from T-pigs consistently contained less total saturated fatty acids (SFA) than C-pigs at each slaughter weight. At 14 kg slaughter weight, carcasses from T-pigs contained 44% less SFA compared to C-pigs. At 28 kg, T-pigs had 42% less SFA; at 48 kg, T-pigs had 5[illegible] less SFA; at 68 kg, T-pigs had 78% less SFA, and at 92 kg, T-pigs contained 85% less SFA than C-pigs. Carcass tissue from T-pigs reflects a much more favorable (lesser quantity) of SFA. A 137% increase in total SFA was observed in C-pigs with increasing live wt (14 to 92 kg) compared to a 40% decrease in total SFA for T-pigs. These differences in SFA were mostly a result of changes in palmitic acid, stearic acid, and myristic acid (not in tabular form). Margaric and arachidic acids were also present but in very small quantities; however, T-pigs did not contain any arachidic (not in tabular form). Palmitic acid accounted for 62% of the total detectable SFA in the C-pigs (92 kg weight group) compared to 66% in T-pigs. Stearic acid accounted for 34% of the total SFA in the C-pigs (92 kg weight group) compared to 30% in T-pigs. Both myristic acid and palmitic acid have been reported to be hyperlipidemic and hypercholesterolemic (KEYS et al, 1965). Human consumption of hypercholesterolemic fatty acids has come under attack by health professionals (NRC, 1988). BONAMONE and GRUNDY (1985)

nstrated that a diet high in stearic acid did not elevate plasma levels of low density
protein (LDL) cholesterol, perhaps because it is poorly digested and can be easily
turated to oleic acid (KEYS et al, 1965).

Carcasses from T-pigs contained less total monounsaturated fatty acids (MUFA) than C-pigs
each slaughter weight (Table 1). At 14 kg slaughter weight, carcasses from T-pigs
tained 48% less MUFA; at 28 kg, 46% less MUFA; at 48 kg, 59% less MUFA; at 68 kg, 79% less
, and at 92 kg, 91% less MUFA than C-pigs. The fatty acids comprising the MUFA were
itoleic, palmitelaidic, oleic, and cis-11-eicosenoic acids. Oleic acid was the major
tributor of MUFA in the total lipid fraction (not in tabular form). The trend was for the
ntity of MUFA to increase with increasing slaughter weight in C-pigs, while a dilution
ect was observed for MUFA in T-pigs after 48 kg live weight. Oleic acid has been reported
be hypolipidemic, reducing cholesterol (GRUNDY, 1986), and it is therefore not considered
be an undesirable dietary fatty acid. MATTSON and GRUNDY (1985) demonstrated that oleic
d had the ability to reduce LDL cholesterol.

Significant differences in the percentage of polyunsaturated fatty acids (PUFA) were
served in the carcass tissue (Table 1) from T- and C- pigs. At 14 kg slaughter weight,
rcasses from T-pigs contained 38% less PUFA; at 28 kg, 24% less PUFA; at 48 kg, 22% less
FA; at 68 kg, 53% less PUFA, and at 92 kg, 66% less PUFA than C-pigs. The trend was for
FAs to increase with increasing live weight in C-pigs and to decrease with increasing
ight in T-pigs. The fatty acids comprising the PUFA were linoleic, linolenic and
rachidonic acids.

CONCLUSIONS

In general, carcass tissue from T-pigs contained significantly less long chain fatty acids
an C-pigs at each of the designated slaughtered weights. In fact, a dilution effect was
served for fatty acid deposition in T-pigs with increasing slaughter weight. On the
ntrary, fatty acid deposition either increased or remained the same with increasing
aughter weight in C-pigs. Carcass tissue from T-pigs reflects much more favorable levels
fatty acids compared to C-pigs when considering dietary health recommendations and
ncerns.

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TABLE 1. COMPARISON OF TOTAL CARCASS LIPID, CHOLESTEROL AND FATTY ACID[a] CONTENT FOR TRANSGENIC[b] AND CONTROL PIGS

Treatment	Weight Group, kg	Total Lipid g/100g	Cholesterol mg/100g	Total SFA	Total MUFA	Total PUFA
Controls	14	10.04	100.88	3.24	3.74	1.51
	28	12.32	94.97	3.69	4.69	2.38
	48	16.58	85.92	5.37	6.73	2.87
	68	26.78	74.15	8.22	8.74	3.95
	92	29.07	77.81	7.67	8.73	3.91
Transgenics	14	6.19	106.45	1.92	1.98	1.08
	28	7.62	99.97	2.20	2.47	1.82
	48	8.16	86.28	2.39	2.50	2.02
	68	5.97	74.55	1.60	1.57	1.63
	92	4.49	77.08	1.15	1.13	1.29
Significance of treatments, P<:						
Treatment (T)		.01	NS	.01	.01	.01
Weight Group (W)		.01	.01	.01	.01	.01
T X W		.01	NS	.01	.01	.01

[a]Grams in 100g sample. SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.
[b]Transgenic pigs = pigs expressing bovine growth hormone gene.