TRAJAN

TECHNICAL ARTICLE

BPX70 FAME Columns for pork - a favorable lipid profile

BPX70

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Introduction

The interaction between nutrition and heart disease has focused recent research on the role of metabolically important fatty acids. Following on from the article in the November 1998 edition of "Solutions" relating to fatty acid levels in pasture and feedlot fed cattle, we now look at the differing fatty acid composition of pork and beef.

Today's gas chromatographer is called upon to analyze food fats and lipids in ever increasing detail. Not only the principal fatty acids present but, more importantly the positional isomers as cis and trans constituents need to be known. The monitoring of FAMEs in natural products such as meat is difficult resulting in many hours of research and development time being spent in order to produce a capillary column optimized for the task.

In the following study, a detailed analysis of fatty acids in intramuscular and storage lipids providing highly quantitative data is described. This was enabled by the usage of the BPX70 capillary column, a highly polar column designed specifically for FAMEs.

Analysis of pork

In some countries, pork has never been as popular as beef. Aside from cultural and religious reasons, this is due in part to consumer perception. Pork has undeservedly maintained a reputation as being comparatively fatty and unhealthy. Even with regular marketing and promotion from the pork industry, it still has not received the popularity it rightfully deserves. Could it be a case of "old habits dying hard"? Do consumers still hold pork in ill repute?

With respect to human nutrition and heart disease, there has been much interest in the benefits of mono- and polyunsaturated fatty acids and the potential dangers of Low Density Lipoprotein (LDL) cholesterol raising saturated fatty acids. Fatty acids appear to differ in their effects on LDL and High Density Lipoprotein (HDL) cholesterol. This may be significant, as LDL and HDL cholesterol appear to have opposing effects on coronary risk, with HDL being protective.

Studies show porcine phospholipids have a favorable lipid profile when compared to beef, having relatively similar concentrations (on a percent composition basis) of certain saturated fatty acids and comparatively high levels of mono- and polyunsaturated fatty acids.

Past research has shown the concentration of palmitic (C16:0) and stearic (C18:0) acids in bovine phospholipid to be approximately 14 and 9% respectively, while the unsaturated oleic (C18:1ω9), linoleic (C18:2ω6), a-linoleic (C18:3ω3) and arachidonic (C20:4ω6) acids are present in the approximate respective concentrations of 20, 12, 2 and 6% (Table 1).

Initial results from this study indicate that porcine phospholipids contain greater relative amounts of palmitic (44% increase) and stearic (14% increase) acids than bovine phospholipids. However, the cholesterol raising effect of saturated fatty acids appears to be limited to lauric (C12:0), myristic (C14:0) and palmitic acids. Of these, myristic acid appears to be the most potent elevator of blood total and LDL cholesterol.

Studies conducted at CSIRO – Department of Human Nutrition in Adelaide, Australia, have indicated that trans-fatty acids may also increase LDL cholesterol. Elaidic (C18:1ω9t) acid is thought to be the transfatty acid responsible. Although present in low concentrations in both species, bovine phospholipids contain approximately 64% more elaidic acid than porcine phospholipids.

With respect to the major polyunsaturated fatty acids present in both species, ω-6 fatty acids, principally alinoleic (C18:2ω6) acid, have been shown to have an independent cholesterol lowering effect which appears to be without threshold over the range of importance in human diets. A major difference in the fatty acid profile of bovine and porcine phospholipids is in the concentration of ω-6 fatty acids. Porcine structural tissue contains close to 26% of α-linoleic acid, which is at least twice the value (12%) recorded for this same fatty acid in bovine tissue phospholipid, and is further evidence of the comparative healthy

Table 1. Fatty acid levels in muscle tissue

Fatty acid	Peak number	% (normalized value) porcine intramuscular phospholipids	% (normalized value) bovine intramuscular phospholipids
C14:0	1	0.5	-
C16:0	3	20.3	14.1
C16:1ω(9)	4	1.3	2.4
C17:0	5	0.6	-
C18:0	6	11.2	9.8
C18:1ω7t	7	1.1	1.8
C18:1ω9	8	20.6	20.4
C18:2ω6t	9	0.7	-
C18:2ω6	10	25.8	12.0
C18:3ω3	11	1.8	2.6
C20:1ω9	12	0.2	-
C20:4ω6	14	14.5	5.6
C22:6ω3	15	1.4	0.3

fatty acid profile of porcine structural tissue. Similarly, the concentration of arachidonic (C20:4ω6) acid for pork tissue phospholipids is two and a half times that found in beef (5.6%).

Bovine phospholipids are reported to contain approximately 0.3% docosahexaenoic acid (C22:6ω3), an ω-3 polyunsaturated fatty acid. From this study porcine phospholipids were shown to contain five times this amount.

Summary

The BPX70 capillary column enabled the detailed analysis of fatty acids in porcine intramuscular and storage lipids.

The separation achievable on this column resulted in highly quantitative data that indicates that the intramuscular phospholipids in pork exhibit a favorable lipid profile when compared to beef, having relatively similar concentrations of the major saturated fatty acids while comparatively higher levels of mono- and polyunsaturated fatty acids.

Information and support

Visit www.trajanscimed.com or contact techsupport@trajanscimed.com

Specifications are subject to change without notice.

Conditions

Part number	054623
Phase	BPX70
Column	60 m x 0.25 mm x 0.25 µm
Initial temperature	100°C
Program rate	100°C for 3.5 min, 50°C/min to 130°C, 5°C/min to 155°C, 2°C/min to 200°C, 5°C/min to 230°C for 8 min, 10°C/min to 270°C for 10 min.
Final temperature	270°C
Carrier gas	H_2, 132 kPa
Carrier gas flow	1.64 mL/min
Detector	FID
Injection mode	Split/Splitless – PTV, 2 mL injection (iso-octane solvent)

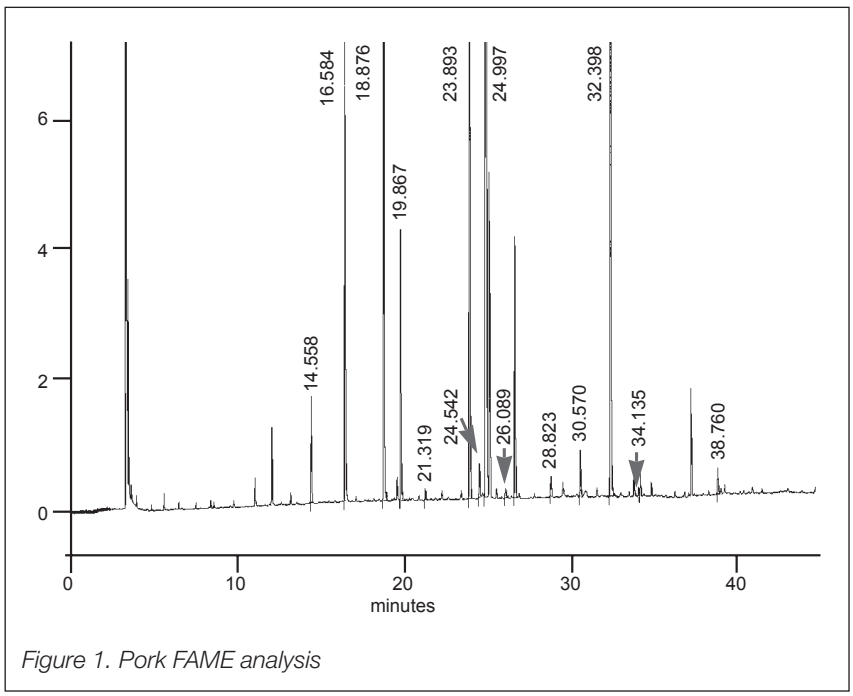

Figure 1. Pork FAME analysis