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RIVO report

Number: C017/04

Sensory analysis of meat from pigs fed with diets containing different microbial biomasses as protein source

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Commissioned by:	Animal Sciences Group Wageningen UR - Voeding P.O. Box 65 8200 AA Lelystad
Contact person:	dr.ir. A.J.M. Jansman
Project number:	356 1222209
Contract number:	03.103
Approved by:	ir. L.J.W. van Hoof Head dept. Seafood & Aquaculture
Signature:	_____
Date:	10 May 2004

Number of copies:	15
Number of pages:	14
Number of tables:	1
Number of figures:	-
Number of annexes:	3

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Summary

This study was carried out to evaluate the effects of using PL73 and PT73 as a dietary protein source in pig diets at a level of 12% over the body weight range of about 30 to 105 kg on the sensory quality of the meat obtained from these pigs.

A sensory analysis for pig meat was organized with a trained sensory panel. The meat samples (M. Longissimus lumborum) were obtained from pigs receiving either a control diet without test product (A) or a diet with 12% of PL73 (D) or PT73 (G). Samples of seven pigs per group were used. The samples were evaluated on 23 sensory attributes.

For almost all attributes there were no significant differences in score between treatments. There was only a significant difference between the control treatment (A) and the group receiving a diet with 12% PL73 (D) for the attribute “tough” in the texture (score 49 and 46, respectively) and between the group receiving a diet with 12% PL73 (D) and the group receiving a diet with 12% PT73 (group G) for the attribute “watery” in the aftertaste (scores 40 and 45 respectively). Both values, however, did not differ from the score for the samples of the control group.

It can be concluded that the overall eating quality of meat from pigs fed with a diet containing either 12% PL73 or 12% PT73 did not differ from meat from the control group fed a standard diet without either one of the test products. Only the meat of pigs fed a diet containing 12% PL73 was considered slightly less tough compared to meat of the control group.

1. Introduction

Two by-products remaining from the production of L-lysine and L-threonine by E. coli (K12) are protein-rich dried biomasses, ''PL 73 E. coli (LYS)'' and ''PT 73 E. coli (THR)", shortly indicated as PL73 and PT73, respectively. These by-products could principally be applied in diets of different animal species including pigs.

For registration of the two by-products information needs to be available on the nutritional value of the products in target animal species and on the possible effects on quality characteristics of the end products.

This study was carried out to evaluate the effects of using PL73 and PT73 as a dietary protein source in pig diets at a level of 120 g/kg over the body weight range of about 30 to 105 kg on the sensory quality of the meat from these pigs.

At the request of the division Nutrition and Food of the Animal Sciences Group in Lelystad, the Netherlands Institute for Fisheries Research (RIVO) in IJmuiden, the Netherlands, organized a sensory analysis the meat from three groups of pigs using a descriptive analysis. This approach would enable to evaluate possible differences between meat samples and to which attributes these differences could be associated. A trained analytical sensory panel was enlisted.

The sensory analysis was performed in the period of 26 January till 27 February 2004.

2 Materials and methods

2.1 Panel

The analytical sensory panel consisted of eight selected and trained persons for analytical sensory research, with experience with the QDA-technique (Quantitative Descriptive Analyses).

2.2 Training

The panel was trained in four one hour during sessions for the sensory assessment of pig meat. These sessions were used to develop a list of attributes suitable for profiling the pig meat samples of this project and to train the panellists for evaluation of the pig meat using this scheme.

During the first session the panellists were asked to describe the pieces of meat for appearance, smell, texture, taste and after-taste, resulting in a list with attributes. During the next three sessions the list was adapted into 23 attributes and the members of the panel were trained for pig meat assessment according to ISO procedure 11035 (1994, Sensory analysis, Identification and selection of descriptors for establishing a sensory profile by a multidimensional approach).
For the first training and selection of attributes market samples were used, obtained from different butchers and supermarkets in Heiloo, The Netherlands. In the last training session also experimental samples from the study were used. These samples were obtained from the three experimental groups: control diet without test product (A) or a diet with 12% of PL73 (D) or PT73 (G) and used to give the panel a scaling reference.
This procedure of using both market samples as well as project samples is familiar in sensory research in order to get the most complete attribute lists for a particular product and to know the intensity range per attribute for the specific products of the project. This forces panellists to use the complete intensity scale for the experimental samples

2.3 Meat

The sample material originated from pigs of three experimental treatments (pigs fed with a control diet without PL73 or PT73 (coded A), pigs fed a diet containing 120 g/kg PL73 (coded D) and pigs fed a diet containing 120 g/kg PT73 (coded G). From each experimental group meat samples of seven random pigs were delivered. Pigs were slaughtered in a commercial slaughterhouse and cooled overnight according to commercial practice. On the next day samples were obtained from the M. Longissimus lumborum from the third caudal vertebra with a length of 12-15 cm. From each sample four slices were prepared with a thickness of about 2 cm. The samples were transported to IJmuiden in a cooled state.
The pig meat was delivered at the Netherlands Institute for Fisheries Research on the 21st of January 2004. On the next day all samples were placed in the fast freezer at –25?C. After fast freezing the samples were stored in a freezer at –25?C until the day of analyses.

There were eight samples in each group (coded 1 - 8) and there were four slices of each sample (coded: 1 - 4).

3. Analyses

The QDA-analyses were carried out according to ISO standard 6564 (1985, Sensory analysis, Methodology flavour profile methods). The list with attributes can be found in Appendix 1.
With the help of the sensory software Compusense® five (Compusense inc., Canada), the set of attributes was projected on the computer screen and the panellists used the mouse to set crosslets at the perceived intensity of this attribute on a continuous intensity line scale from 0-100, with anchors on 10 and 90% (0 meaning very low intensity and 100 very high intensity).
For the test artificial daylight (T>5000K) was used.

4. Preparation

At least one hour before the test the pig meat was taken from the freezer and unfrozen under cold running tap water. The slices were baked on a baking tray. The baking tray was spread with a little ground-nut oil, and set up on 180?C. The temperature of the backing tray was measured with an analogue surface contact thermometer. The slices were baked for 30 seconds each side and thereafter four minutes each side. The slices were then baked well done. Cooking as steaks on a plate gave a good all round sensory analysis with focus on appearance, flavour and texture (1). The outside of the slice was taken away whereupon the centre of the slice was cut in four pieces, of approximately 2 by 2 cm, for four panellists.

5. Design

In total 21 samples (three experimental groups and meat of 7 pigs per experimental group) were presented in 6 sessions. Each session the panellists analysed 6 or 7 meat samples. One slice could be used for maximum four panellists. This means that for each sample two slices (out of four available for sensory analyses) were used. The performance of the panel in terms of repeatability was analysed by using duplicate assessments both within and between sessions. For the duplicate assessments (18 in total) the remaining two slices were used. The samples were distributed to the panellists at random according to an incomplete block design (see table 1). The presentation order was randomised between four panellists.

Table 1. Incomplete block design of the sensory evaluation of pig meat.

Session day	Sample	*Slice*	Sample	*Slice*	Sample	*Slice*	Sample	*Slice*	Sample	*Slice*	Sample	*Slice*	Sample	*Slice*
Day 1	1A	*1-2*	1A[a]	*3-4*	3A	*3-4*	2D	*1-2*	7G	*3-4*	8D	*1-4*	6G	*1-3*
Day 2	5D	*1-2*	5D[a]	*3-4*	6A	*2-4*	8G	*1-2*	7D	*3-4*	3D	*2-4*		
Day 3	1G	*1-2*	1G[a]	*3-4*	3D[b]	*1-3*	8G[b]	*3-4*	6A[b]	*1-3*	7A	*3-4*	6D	*2-4*
Day 4	5A	*1-2*	5A[a]	*3-4*	4A	*1-3*	8D[b]	*2-3*	7G[b]	*1-2*	5G	*2-3*		
Day 5	3G	*1-2*	3G[a]	*3-4*	7A[b]	*1-2*	7D[b]	*1-2*	1D	*2-3*	4A[b]	*2-4*	2A	*1-4*
Day 6	4G	*1-2*	4G[a]	*3-4*	5G[b]	*1-4*	1D[b]	*1-4*	3A[b]	*1-2*	2D[b]	*3-4*		

[a] – duplo in the same session

[b] – duplo in different sessions

6. Statistical analyses

The statistical analysis was performed in SAS (release 8.1). The means per sample and per attribute were counted (see Appendix 2). Analyses of Variance (ANOVA) was used to judge the overall significance of differences ($P<0,05$) between the experimental groups and samples. A post hoc-test (Tukey) was used to evaluate contrast between treatments.

7. Results and discussion

The average temperature of the baking tray was 160 -180°C. Although this variation in temperature of the baking tray, effects on the final result are likely to be small due to the randomised design used.

Literature (1) shows that there is an effect of cooking technique and core temperature on the results of the sensory analysis of pig meat, depending on the raw meat quality. For eating quality assessment the used method is most valuable and the effect of different core temperatures on sensory evaluations is minimal.

As each group within the sensory evaluation consisted of meat samples of seven individual animals, it is possible that these individuals had different sensory properties. Statistical analyses of the results within the experimental groups, however, did not show significant differences between individuals.

Analyses of variance showed that there was no significant difference between the duplicate samples, meaning panel has assessed repeatedly.

The mean results of the sensory analysis can be found in Appendix 2. With ANOVA the main effect (treatment effect) is analysed.

For most attributes there was no significant difference between the experimental treatments. There was only a significant difference between the control treatment (A) and the group receiving a diet with 12% PL73 (D) for the attribute “tough” in the texture (score 49 and 46, respectively) and between the group receiving a diet with 12% PL73 (D) and the group receiving a diet with 12% PT73 (group G) for the attribute “watery” in the aftertaste (scores 40 and 45 respectively). Both treatments D and G did not differ from the control treatment for the attribute “watery” in the aftertaste.

It can be concluded that the overall eating quality of meat from pigs fed with a diet containing either 12% PL73 or 12% PT73 did not differ from meat from the control group fed a standard diet without either one of the test products. Only the meat of pigs fed a diet containing 12% PL73 was considered slightly less tough compared to meat of the control group.

8 References

1. Bejerholm, Camilla, Aaslyng, Margit Dall, 2003. The influence of cooking technique and core temperature on results of a sensory analysis of pork - depending on the raw meat quality, Food Quality and Preference, volume 15:19-30.

APPENDIX 1 List of attributes with descriptions

Characteristic	Attribute	Description
Appearance	Shining	How much the meat shines just after baking
	Pink colour	The amount of the pink colour
	Beige colour	The amount of the beige colour
	Brown colour	The amount of the baked crust
	Fibres	The amount of fibres you can see on the appearance of the baked slice
Odour	Baking odour	The smell of baking odour
	Bouillon	The smell of bouillon
	Sweet	A sweet smell like sugar
Texture	Firm	The firmness of the meat
	Fibres	Fibres that arises during chewing and they are difficult to cut up
	Juicy	The amount of juiciness
	Dry	The dryness of the meat during chewing
	Tough	Is the slice easy or difficult to chew with little or big force
Taste	Sweet	The sweet taste of meat and juiciness
	Sour	The sour like vinegar
	Watery	The neutral taste of the juiciness coming free when chewing
	Bouillon	The taste of bouillon in the meat
	Liver	Think of the taste of a liver sausage
Aftertaste	Bouillon	The aftertaste of bouillon in the meat
	Metal	Fresh taste, think of licking some metal after scrubbing with sandpaper
	Liver	Think of the taste of a liver sausage
	Bitterness	Think of the bitterness of coffee
	Watery	Think of the neutral taste of the juiciness

APPENDIX 2

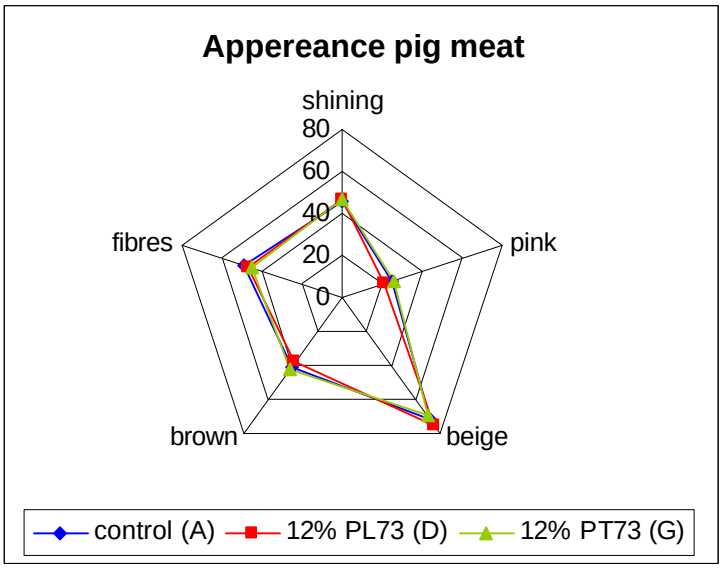
Results sensory analysis of pig meat (n = 7, intensity score 0-100)

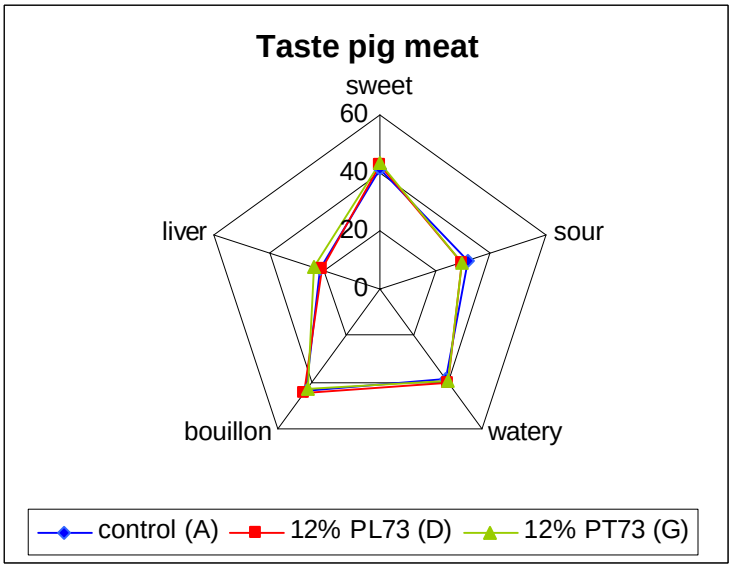
	Attribute	Control (A)	12% PL73 (D)	12% PT73 (G)
Appearance	shining	45	46	46
	pink	25	21	25
	beige	71	76	70
	brown	41	38	42
	fibres	50	47	45
Odour	baked odour	50	49	50
	bouillon	40	40	42
	sweet	46	45	47
Texture	firm	59	60	59
	fibres	60	62	58
	juicy	48	49	44
	dry	49	50	53
	tough	49 [A]	46 [B]	45 [AB]
Taste	sweet	41	42	44
	sour	32	30	30
	watery	39	40	39
	bouillon	43	44	42
	liver	22	21	24
Aftertaste	bouillon	36	38	34
	metal	31	31	27
	liver	19	19	20
	bitterness	15	15	16
	watery	44 [AB]	40 [A]	45 [B]

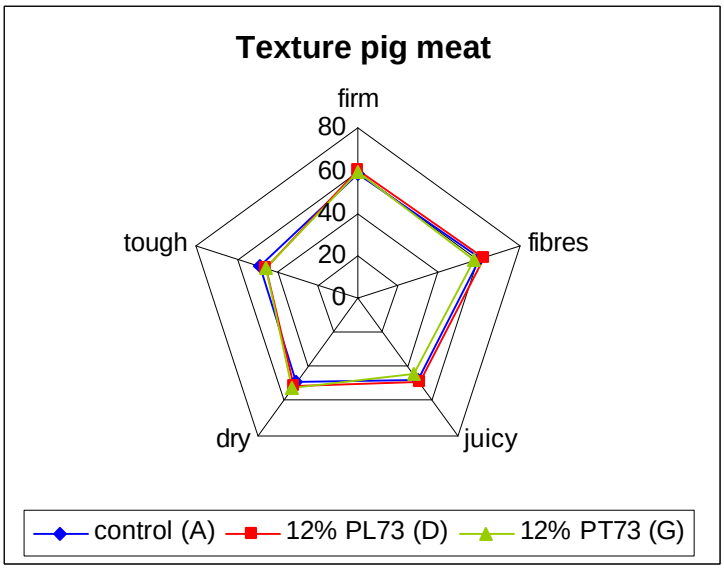
[A,B] Values with a different superscript within the same row differ significantly at P<0,05

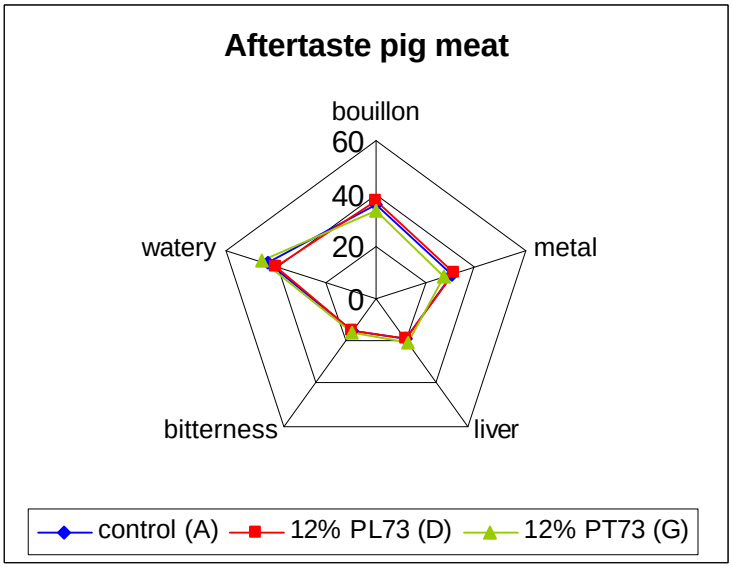
APPENDIX 3

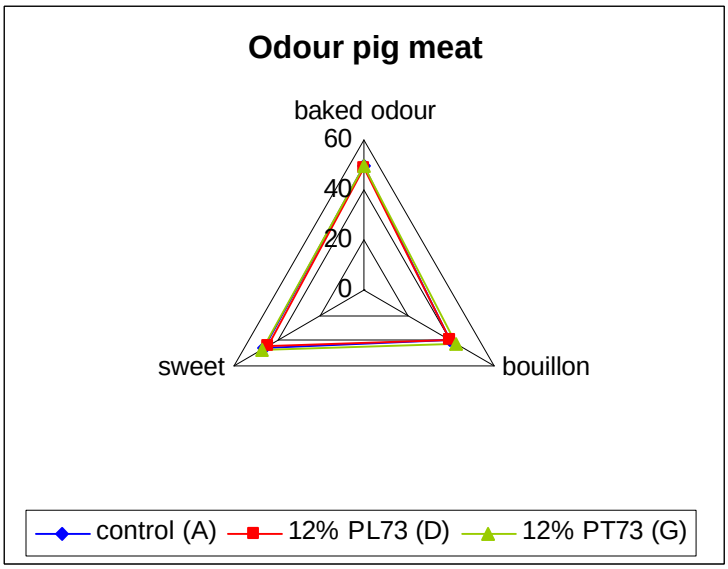
Spider plots, showing the sensory profiles of pig meat of three experimental groups


Appereance pig meat
shining
80
60
40
20
0
pink
beige
brown
fibres
control (A)
12% PL73 (D)
12% PT73 (G)


Taste pig meat
sweet
60
40
20
0
sour
watery
bouillon
liver
control (A)
12% PL73 (D)
12% PT73 (G)


Texture pig meat
firm
80
60
40
20
0
tough
fibres
dry
juicy
control (A)
12% PL73 (D)
12% PT73 (G)


Aftertaste pig meat
bouillon
60
40
20
0
watery
metal
bitterness
liver
control (A)
12% PL73 (D)
12% PT73 (G)


Odour pig meat
baked odour
60
40
20
0
sweet
bouillon
control (A)
12% PL73 (D)
12% PT73 (G)