PRODUCTIVITY TRAITS AND MEAT QUALITY OF PIGS FED WITH AN ORGANIC DIET CONTAINING A NEW TYPE OF LUPIN

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Background

The new EU legislation concerning production of organic pig meat restricts the possibilities of composing an optimal diet for organically produced pigs. These restrictions are primarily on the protein sources for pigs. As of August 2000, it is allowed to supply the organic feed with 20% conventional feed but addition of synthetic amino acids and soybean meal is no longer allowed. As of 2005, all the feed has to be of organic origin. Therefore there is an acute need for alternative protein sources of organic origin for the organic pig production. During the last couple of years a new type of lupin has been developed with the purpose of having a new protein source for growing and feeding organically. When new raw materials are used in a pig diet, it is necessary to test if and how these raw materials affect the productivity and the meat quality.

Objectives

The purpose of this trial was to investigate how the addition to the feed of organically grown lupin of the type Prima affected the productivity and the meat quality of pigs fed with either conventional, organic, or organic feed to which lupin had been added, respectively.

Methods .

The pigs were produced at a trial station. Each group consisted of 18 repetitions of 10 pigs each - in total 180 pigs per group. In total, 540 pigs were produced. The pigs were inserted in pens of ten pigs each with one feed dispenser and one nipple drinker per pen. The pigs were transferred to the trial at an average weight of 27.8 kg and slaughtered at averagely 97.6 kg live weight. The pigs were divided randomly into three groups fed with 1) a conventional diet (36% wheat, 36% barley, 22% soybean meal, synthetic amino acids), 2) an organic diet (organically produced raw materials: 10% wheat, 28% barley, 10% oats, 8% peas, 11% rape cakes, 13% soy beans), or 3) an organic diet with lupines (45% barley, 15% wheat, 4% soybeans, 5% peas, 9% rape cake, **15% lupin**). All pigs were fed ad libitum for the entire period. The pigs in all groups were raised under traditional conditions in order to eliminate all other effects but those of the diet. Daily feed intake, feed conversion ratio, daily weight gain and lean meat percentage were recorded. The gross margin per pig (GM) was calculated as: GM= market price based on slaughter weight and lean meat percentage – price at insertion – feed costs – other costs. The production value (PV) i.e. gross margin per place unit per year were calculated as: GM*(365 days/feeding days per pig)*utilisation of the stable (90%)). The calculations used do not take into account the fact that the price of organic feed is higher than that of conventional feed as the production value expresses the effect of productivity. The PV was subjected to an analysis of variance in SAS under the procedure GLM. The model used was: PV = diet + pen + repetition + *e*. Statistical differences at 5% level are corrected for the 3 comparisons in pairs by a Bonferroni t-test.

From each diet group 12 gilts and 12 castrates were selected for analysis of the meat quality traits of *M. longissimus dorsi* pH_{24h}, sensory profile, fatty acid composition (triglycerides and phospholipides), intramuscular fat (IMF), pigment, meat colour (Minolta), drip loss, shear force (Wolodkewich) and fatty acid composition (triglycerides) of the back fat. The meat quality traits were analysed by the SAS procedure Mixed and the model used was: Trait = diet + sex + day of slaughter + weight of hot carcass + diet*sex + diet*day of slaughter + sex*day of slaughter + pen(feed) + *e*.

Results and discussion

The analyses of the feed showed that the contents of raw protein were 0.5 and 1% higher in diets 2 and 3, respectively, than in the control diet 1. The reason for this is that it is possible to adjust the amino acid content in the conventional diets with synthetic amino acids. In the organic diets, amino acid content can only be adjusted by increasing the content of raw protein. All diets had a slightly lower content of the essential amino acids than calculated. As the differences were at the same level, this has not affected the conclusion of the trial. The analyses of the content of fatty acids showed that the organic diets had a higher content of monounsaturated fatty acids than the conventional diet, and the content of polyunsaturated fatty acids was higher in the conventional diet. Furthermore, the iodine value was almost identical in the three diets: 114, 113 and 110, respectively. The contents of raw fat in the three diets were 4.5, 6.5, and 4.9. The higher content of raw fat in the traditional organic diet 2 caused the iodine product to be 20 units higher in diet 2 compared with the other groups. The iodine product for diets 1, 2, and 3 were 50, 73 and 54, respectively (Figure 1). The Danish recommendations for iodine product in feed to avoid a poor fat quality are 62 (stolt HCl petrol ether method) in order to avoid iodine values above 70 in the fat. The production value (PV) was significantly lower for the pigs fed the traditional, organic diet 2 than the pigs fed the control diet 1 and the organic diet 3 containing lupin. This can be explained by a higher feed intake and lower daily weight gain in the group fed the traditional organic diet. There were no differences in feed conversion or lean meat percentage between the three groups (Table 1).

There were very few and small differences in the sensory profile and there were no significant differences in pH_{24h}, IMF, drip loss, shear force and meat colour except for a slightly higher b-value (yellow) for diet 3 (data not shown). The fatty acid composition of back fat is shown in figure 2. The content of SFA is higher for the conventional diet and lower for the traditional, organic diet. The content of MUFA is lower for the conventional diet and higher for the organic diet with lupin. The content of PUFA is higher for the traditional, organic diet and lower for the organic diet with lupin. All differences are significant ($p<0.05$). The iodine value (the degree of "unsaturatedness") is significantly higher for the traditional, organic diet (probably caused by the higher iodine product in this diet), but the same for the two other diets. For reasons unknown, the iodine value of the back fat was very high for all three diets, the normal being approx. 70. The fatty acid composition of the triglycerides of *M. longissimus dorsi* shows nearly the same pattern, but this is not the case for the phospholipids although there are differences between the three diets (data not shown).

Conclusion

1. Lupin can be used as a realistic alternative to the existing protein sources of organic pig production without any negative influence on the efficiency of the productivity traits for finishers. The productivity of the group fed the diet that contained lupin was at the same level as that of the pigs fed the conventional diet.

2. Compared with the two other diets, the sensory quality and the meat quality were not affected by the use of lupin in the feed except for the fatty acid composition. For fresh consumption the consumer will probably not experience any difference. The differences in fatty acid composition may influence the quality of processed pork products, but feeding with all three diets generally resulted in an unacceptably high content of unsaturated fatty acids in the back fat - the reason for this being unknown at this moment.

Tables and figures.Table 1: Productivity traits and production value for pigs fed three different diets. Values in a row marked with different letters are significantly different (p>0.05)

Group	1	2	3
No. of pigs inserted	180	180	180
Daily weight gain	872[a]	817[b]	850[a]
Feed intake FUp/kg (kg/kg)	2.40[a]	2.25[b]	2.32[c]
Feed conversion FUp/kg (kg/kg)	2.76	2.75	2.74
Lean meat %	60,3	59,6	59,8
Production value DKK (index)	644[a] (100)	590[b] (92)	619[a] (96)

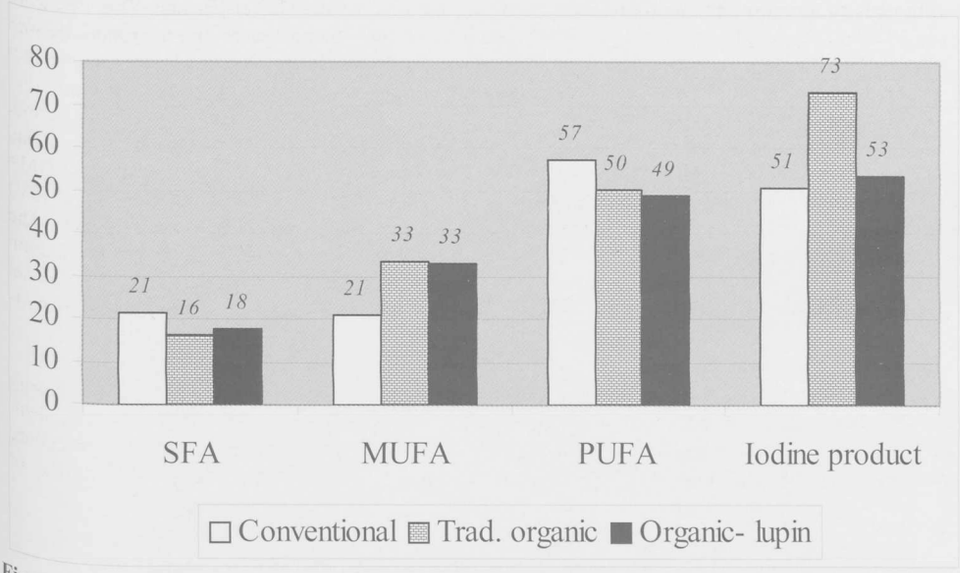

Figure 1. Fatty acid composition of the fatty acid fraction (relative percent) and iodine product of the diets. SFA: Saturated fatty acids. MUFA: Monounsaturated fatty acids. PUFA: Polyunsaturated fatty acids.

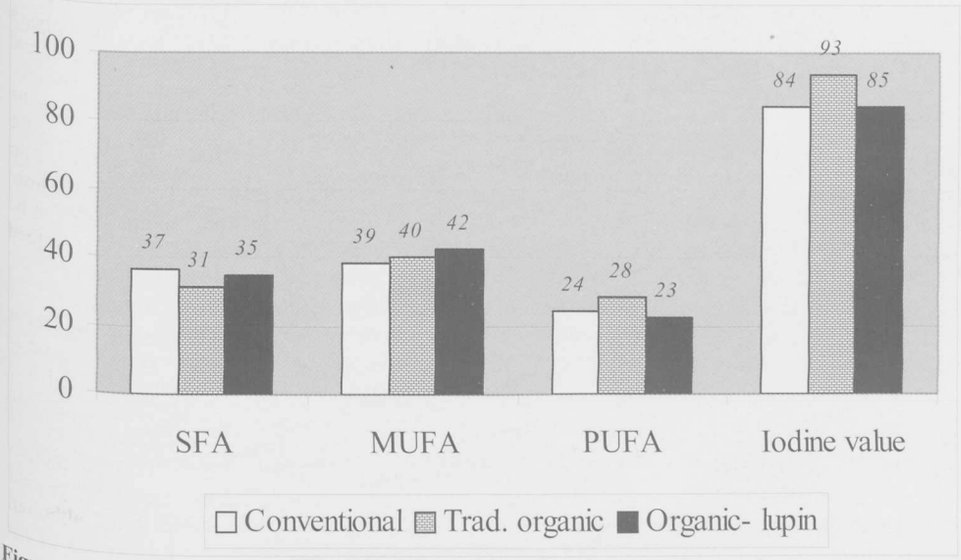

Figure 2. Fatty acid composition of the triglyceride fraction (relative percent) and iodine value of back fat. SFA: Saturated fatty acids. MUFA: Monounsaturated fatty acids. PUFA: Polyunsaturated fatty acids.