Wheat protein C*HYPROW for weaners

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Abstract
The aim of the trial was to investigate the effect in the production of using hydrolysed wheat protein, C*HYPROW (Cerestar HYPROW 21100), as an alternative to fish meal. A control diet containing fish meal was compared with two trial diets with different content of C*HYPROW and potato protein concentrate from AKV-Langholt.

Group 1: Control diet containing fish meal.
Group 2: Diet 1 containing 8 % C*HYPROW and diet 2 containing 5 % C*HYPROW.
Group 3: Diet 1 containing 5 % C*HYPROW and 4 % AKV potato protein concentrate and diet 2 containing 5 % C*HYPROW and 3 % AKV potato protein concentrate.

The diets containing C*HYPROW and no potato protein concentrate (group 2) resulted in a significantly lower production value compared with the control group. The combination of C*HYPROW and potato protein concentrate (group 3) resulted in the same production value as the control group. The lower production value in group 2 was probably caused by a valine deficiency compared with the standard. The current production value, including the price of the diets, was 10 % lower in group 2 and 5 % lower in group 3 compared with the control group. C*HYPROW in combination with potato protein concentrate could be a realistic alternative to fish meal and soy protein. However, in order for the economy to be balanced, the price must be competitive and the standards for all essential amino acids must be met.

Introduction
New protein sources for pigs are constantly being developed. Cerestar have developed hydrolysed wheat protein for weaners, which was tested in two different dosages in diets with and without the addition of AKV potato protein concentrate. Hydrolysed wheat protein can be used as an alternative to fish meal or soy products. C*HYPROW is a secondary product from production of starch from wheat and is hydrolysed by way of enzymes.

The trial cannot conclude whether the individual products affect the productivity of weaners. However, the results are able to give some indication of how the pigs managed on the diets to which the tested protein sources were added, as the studied protein sources were unable directly to replace another ingredient or could be "poured on top" of the control feed.

The aim of the trial was to investigate the effect in the production of using diets without fish meal, but containing the wheat product C*HYPROW from Cerestar. The effect was measured on the production results daily gain, feed intake and feed conversion that were included in the calculation of the production, which was the primary parameter. Treatments for diarrhoea and mortality were measured as secondary parameters.

Materials and method
The trial was conducted at experimental station Grønhøj, which is an SPF herd purchasing 5-week-old pigs. The trial was conducted in the weaner facilities. Each facility contained eight pens with an average of 23 pigs per pen. The pens in a facility had either fully slatted floors or

partially slatted floors. They measured 210 cm x 350 cm, and were evenly distributed on either side of an inspection alley. Each pen had one feeder with trough separation and one drinking bowl.

Each group comprised 16 replicates with 23 pigs, totalling 368 pigs per group.

The pigs were transferred to the trial at an average weight of 8.2 kg. At intermediate weighing after two weeks, when the pigs switched from diet 1 to diet 2, the average weight was 11.8 kg. Six weeks after transfer, the pigs were moved to the finisher facility at an average weight of 30.2 kg.

Feed
The two trial diets did not contain fish meal. The trial diets contained different dosages of C*HYPROW and AKV potato protein concentrate, and were formulated on the basis of Cerestar's recommendations and analyses of nutrient content of C*HYPROW (see tables 1, 2 and Appendix 1).

When the trial diets were formulated, it was not possible to meet the standard for valine; the valine content was between 7 % and 20 % below the standard to be able to dose C*HYPROW in the amount desired by the company (Appendix 2) [1]. The composition of the diets is shown in details in Appendix 3.

Table 1. Primary protein sources in diet 1 (first two weeks post-weaning)

Group	**1**	**2**	**3**
Fish meal	10	-	-
C*HYPROW	-	8	5
Potato protein	-	-	4

Table 2. Primary protein sources in diet 2 (last four weeks post-weaning)

Group	**1**	**2**	**3**
Fish meal	5	-	-
C*HYPROW	-	5	5
Potato protein	-	-	3
Dehulled soyabean meal	10	9	6

All diets were produced over two times at Aarhusegnens Andel. Upon each production of feed, samples were collected for analyses of content of energy (FUgp), lysine, methionine, cystine, threonine, calcium and phosphorus.

The pigs were fed ad libitum and the change from diet 1 to diet 2 took four to five days.

Recordings
All recordings were made at pen level. The pigs were weighed upon transfer to the trial, when switching from diet 1 to diet 2 (intermediate weighing), and when the trial ended six weeks after transfer. The amount of feed used was calculated at intermediate weighing and upon departure from the weaner facility. Mortality and treatments for diarrhoea and other diseases were recorded.

Production value
The production value based on an average of the prices of the last five years for weaners (September 2000 – September 2005) was calculated as: (kg gain x DKK per kg gain) − (number of analysed FUgp x DKK per FUgp). The value of gain was calculated on the basis of the average

start and finish weights of the trial. The price of pigs weighing 7 kg was DKK 214/kg, ± DKK 8.52/kg, and for pigs weighing 30 kg DKK 357/kg, + DKK 5.08/kg (15-30 kg) / ÷ DKK 5.24/kg (30-40 kg). The price used for diet 1 was DKK 2.74 per FUgp, and for diet 2 DKK 1.52 per FUgp.

The prices used for calculating the current production value were an average of the prices of the last six months (autumn 2005):

- LT fish meal: DKK 515 per 100 kg
- Regular fish meal: DKK 460 per 100 kg
- C*HYPROW: DKK 590 per 100 kg
- AKV potato protein concentrate: DKK 660 per 100 kg

Statistics
The production value was calculated as primary parameter with weight at transfer to the trial as co-variable. The model included the following variables: block and group. Data were analysed for normal distribution and prevalence of outliers, and were subjected to an analysis of variance in SAS under the GLM procedure. Significant differences were stated at 5 per cent level. Data were subjected to a Bonferroni adjustment for three comparisons in pairs (all groups were compared with each other).

Mortality and disease treatments were secondary recordings in the trial.

Results and discussion

Feed analyses
The analysed nutrients in diet 1 for the control group complied with the nutrient standards. In group 3, the content of lysine, methionine and threonine was 4-6 % below the declaration, but since the diets were formulated with 5 % extra of the first four essential amino acids, they almost complied with the standards.

The analysed nutrients in diet 2 for the control group corresponded with the declared content. The methionine content was 5 % below the declared content in the feed for groups 2 and 3, but since the diets were formulated with 5 % extra of the first four essential amino acids, they almost complied with the standards.

The analysis results are shown in Appendix 4.

Health
There was no difference between the groups in terms of mortality or number of treatments for diarrhoea. Each pig was treated for an average of 2.3 days, of which 2.1 were treatments for diarrhoea. Mortality averaged 3.8 % and 6.6 % were culled from the trial. Mortality and culling rate were high especially after intermediate weighing in the first round. This was due to inefficient treatment for diarrhoea caused by resistance to most types of antibiotics. Subsequently, a new type of antibiotic was taken into use that had an effect on the coli bacteria of the herd. If data from the first four blocks were excluded from the data material, 12 blocks were left. In those 12 blocks, mortality averaged 2 %, and 6.2 % of the pigs were culled. An average of 0.4 days per pig were spent on treatment, of these 0.2 were for diarrhoea. Production value, mortality and frequency of disease treatments were unaffected by whether data from the first blocks were excluded, and they were therefore kept in the data.

Productivity
Group 2 had a significantly lower production value than the control group primarily caused by a reduced feed intake and daily gain. Group 2 tended to have a lower production value than group 3, but group 3 did not deviate from the control group. There was no difference in pro-

duction value between group 3 and the control group (see table 3). The reduced productivity among the pigs in group 2 may be caused by a valine deficiency, which affects feed intake negatively and thereby reduces daily gain as seen in this trial.

Table 3. Production results and production value

Group	**1**	**2**	**3**
Product	**Control**	**C* HYPROW**	**C* HYPROW + potato protein conc.**
Blocks	16	16	16
Pigs	374	374	374
First 2 weeks post-weaning			
Weight at transfer, kg	8.2	8.2	8.2
Daily gain, g	271	233	251
Daily feed intake, FUgp (kg)	0.40 (0.33)	0.35 (0.29)	0.39 (0.32)
Feed conversion, FUgp/kg gain (kg)	1.51 (1.22)	1.58 (1.29)	1.59 (1.30)
2-6 weeks post-weaning			
Weight at intermediate weighing, kg	12.1	11.6	11.8
Daily gain, g	571	527	560
Daily feed intake, FUgp (kg)	1.05 (0.89)	0.96 (0.81)	0.99 (0.85)
Feed conversion, FUgp/kg gain (kg/kg)	1.84 (1.56)	1.83 (1.54)	1.78 (1.51)
The entire trial period			
Weight at end of trial, kg	31.0	29.2	30.3
Daily gain, g	477	434	463
Daily feed intake, FUgp (kg)	0.84 (0.71)	0.77 (0.65)	0.80 (0.68)
Feed conversion, FUgp/kg gain (kg/kg)	1.78 (1.50)	1.78 (1.50)	1.74 (1.47)
Production value			
DKK per pig*	70.3[a]	64.7[b]	69.9[a]
Index	100	92	99

a,b: There must be a minimum difference of DKK 5.5 per pig corresponding to 8 index points in order for the difference to be significant.

* There was a tendency (P=0.07) towards group 2 having a lower production value than group 3.

A previous trial demonstrated that weaners were able to manage on feed that did not contain fish meal without this having a negative effect on productivity. The trial also demonstrated that it was possible to replace fish meal with a diet that, in terms of price, was identical to the control diet [2].

Current production value

The current production value, including the price of the diets, showed that the production value was 10 % lower in group 2 and 5 % lower in group 3 compared with the control group (see table 4). The feed prices were calculated on the basis of the ingredient prices used in feed deals 05/06.

Table 4. Current production value based on the prices of the diets

Group	**1**	**2**	**3**
Product	**Control**	**C* HYPROW**	**C* HYPROW + potato protein conc.**
DKK per pig*	76.1	68.9	72.2
Index	100	90	95

***** No statistical calculations were made on the current production value.

Conclusion

The diets containing C*HYPROW and no potato protein concentrate (group 2) resulted in a significantly lower production value compared with the control group. The combination of C*HYPROW and potato protein concentrate (group 3) resulted in the same production value as in the control group. The reduced production value was probably caused by a valine deficiency compared with the standard. The current production value, including the price of the diets, was

10 % lower in group 2 and 5 % lower in group 3 compared with the control group. C*HYPROW in combination with potato protein concentrate could be a realistic alternative to fish meal and soy protein. However, in order for the economy to be balanced, the price must be competitive and the standards for all essential amino acids must be met.

References

[1] Jørgensen, L. & P. Tybirk, 2005. Normer for næringsstoffer. Infosvin.
[2] Jørgensen, L. 2004. Weaner feed without fish meal. Report no. 652. The National Committee for Pig Production.

Trial: 850

Participant: Jens Ove Hansen, the National Committee for Pig Production

Appendix 1

Nutrient composition of C*HYPROW (supplied by Cerestar)

Water, %	5.0
Crude protein, %	80.0
Ashes, %	1.1
Fat, %	5.0
Fibre, %	0.5
Nitrogen-free extract, %	8.4
FUgp/kg	1.33
Lysine, g/kg	13
Methionine, g/kg	13
Cystine, g/kg	16
Threonine, g/kg	21
Tryptophan, g/kg	7
Isoleucine, g/kg	25
Leucine, g/kg	53
Histidine, g/kg	16
Phenylalanine, g/kg	40
Tyrosine, g/kg	25
Valine, g/kg	28
Calcium, g/kg	0.5
Phosphorus, g/kg	2.0
Potassium, g/kg	1.5
Sodium, g/kg	0.8
Chloride, g/kg	1.0
Iron, mg/kg	40

Appendix 2

Calculated content of amino acids in diet 1 (6-9 kg).

Amino acid	**DK standard requirements**	**1. Control**			**2. Cerestar**			**3. Cerestar**		
	g digestible per FUgp	**g /kg feed**	**g digestible / FUgp**	**% deviation from DK standard**	**g/kg feed**	**g digestible / FUgp**	**% deviation from DK standard**	**g/kg feed**	**g digestible / FUgp**	**% deviation from DK standard**
Lysine	10.8	13.6	11.4	**5.6**	13.6	11.4	**5.6**	13.6	11.4	**5.6**
Methionine	3.5	4.4	3.7	**5.7**	4.4	3.6	**2.9**	4.4	3.7	**5.7**
Methionine+ cystine	5.8	7.3	6.1	**5.2**	8.1	6.7	**15.5**	7.8	6.5	**12.1**
Threonine	6.5	8.2	6.8	**4.6**	8.2	6.8	**4.6**	8.2	6.8	**4.6**
Tryptophan	1.9	2.4	2.0	**5.3**	2.4	2.0	**5.3**	2.4	2.0	**5.3**
Isoleucine	6.4	8.1	6.8	**6.3**	7.4	6.2	**-3.1**	7.7	6.5	**1.6**
Leucine	10.9	13.3	11.1	**1.8**	12.8	10.7	**-1.8**	13.5	11.2	**2.8**
Histidine	3.6	4.5	3.7	**2.8**	4.2	3.5	**-2.8**	4.1	3.4	**-5.6**
Phenyla-lanine	6.1	8.3	6.9	**13.1**	8.9	7.4	**21.3**	9.1	7.6	**24.6**
Phenyla-lanine + ty-rosine	12.0	14.3	11.9	**0.8**	15.1	12.6	**5.9**	15.7	13.1	**9.2**
Valine	7.6	9.3	7.7	**1.3**	7.4	6.1	**-19.8**	8.28	6.9	**-9.2**
Crude protein	155	190	158	**1.9**	190	158	**1.9**	186	155	**1.9**

Appendix 2 cont.

Calculated content of amino acids in diet 2 (9-30 kg).

Amino acid	**DK standard requirements**	**1. Control**			**2. Cerestar**			**3. Cerestar**		
	g digestible per FUgp	**g /kg feed**	**g digestible / FUgp**	**% deviation from DK standard**	**g/kg feed**	**g digestible / FUgp**	**% deviation from DK standard**	**g/kg feed**	**g digestible / FUgp**	**% deviation from DK standard**
Lysine	9.8	11.8	10.3	**5.1**	11.8	10.3	**5.1**	11.8	10.3	**5.1**
Methionine	3.1	3.7	3.3	**6.5**	3.8	3.3	**6.5**	3.7	3.3	**6.5**
Methionine + cystine	5.2	6.5	5.7	**9.6**	7.1	6.1	**17.3**	7.0	6.1	**17.3**
Threonine	6.0	7.2	6.3	**5.0**	7.3	6.3	**5.0**	7.2	6.3	**5.0**
Tryptophan	1.8	2.1	1.8	**0**	2.1	1.8	**0**	2.1	1.8	**0**
Isoleucine	5.7	7.3	6.3	**10.5**	7.0	6.1	**7.0**	7.1	6.2	**8.8**
Leucine	10.0	11.8	10.2	**2.0**	11.8	10.3	**3.0**	12.4	10.8	**8.0**
Histidine	3.3	4.1	3.6	**9.1**	4.1	3.5	**6.1**	3.9	3.4	**3.0**
Phenylalanine	5.6	7.7	6.7	**19.6**	8.3	7.2	**28.6**	8.5	7.4	**32.1**
Phenylalanine + tyrosine	11.0	13.4	11.7	**6.4**	14.2	11.3	**11.8**	14.8	12.8	**16.4**
Valine	7.0	8.1	7.1	**1.4**	7.2	6.3	**-10.0**	7.6	6.6	**-5.7**
Crude protein	148	170	148	**0**	174	151	**2.0**	174	151	**2.0**

Appendix 3

Composition of diet 1 (% of ingredients)

Ingredients	**1**	**2**	**3**
	Control	**Cerestar**	**Cerestar**
Wheat	60.00	58.57	60.94
Barley	7.41	8.64	7.00
HP300	10.83	10.25	8.67
C*HYPROW	-	8.00	5.00
Fish meal LT	9.61	-	-
Dried whey	5.00	5.00	5.00
AKV potato protein concentrate	-	-	4.00
Vegetable fat Scanfedt S	3.10	3.38	3.45
Molasses	1.00	1.00	1.00
Dietary salt	0.18	0.33	0.34
Monocalcium phosphate	0.89	1.81	1.80
Feed lime	0.83	1.07	1.08
Lysine 98.5%	0.42	0.93	0.77
DL-Methionine 100%	0.07	0.16	0.15
L-Threonine 98.5%	0.14	0.27	0.20
L-Tryptophan 15%	0.17	0.24	0.25
Vitamins & minerals	0.35	0.35	0.35

Composition of diet 2 (% of ingredients)

Ingredients	**1**	**2**	**3**
	Control	**Cerestar**	**Cerestar**
Wheat	52.78	53.38	56.74
Barley	15.00	15.00	15.00
Soybean meal, toasted	9.53	8.65	5.68
Dehulled soybean meal	9.53	8.65	5.68
C*HYPROW	-	5.00	5.00
Fish meal	5.00	-	-
AKV potato protein concentrate	-	-	3.00
Vegetable fat Scanfedt S	3.16	3.18	2.75
Molasses	1.50	1.50	1.50
Dietary salt	0.29	0.40	0.40
Monocalcium phosphate	0.80	1.27	1.35
Feed lime	1.47	1.63	1.61
Lysine 98.5%	0.40	0.67	0.64
DL-Methionine 100 %	0.08	0.12	0.10
L-Threonine 98.5%	0.13	0.20	0.16
L-Tryptophan 15%	0.07	0.09	0.13
Vitamins & minerals w. phytase	0.26	0.26	0.26

Appendix 4

Analysed and declared nutrient content of diet 1 (two feed productions)

Group	1. Control		2. Cerestar		3. Cerestar	
	Declared	Analysed[1]	Declared	Analysed	Declared	Analysed
FUgp/100 kg	120	124	120	122	120	123
Crude protein, %	21.0	21.2	20.9	20.1	20.7	20.6
Crude fat, %	5.7	6.0	5.6	5.6	5.6	5.5
Lysine, g/kg	14.7	14.9	14.4	14.5	14.7	14.1
Methionine, g/kg	4.7	4.9	4.6	4.4	4.7	4.4
Methionine + cystine, g/kg	8.0	8.5	8.7	8.4	8.6	8.6
Threonine, g/kg	9.0	9.3	8.9	8.5	9.1	8.6
Calcium, g/kg[2]	8.4	9.6	8.4	9.4	8.4	9.4
Phosphorus, g/kg[2]	7.3	7.6	7.5	7.8	7.4	7.7
1) Average of six analyses						
2) Average of three analyses						

Analysed and declared nutrient content of diet 2 (two feed productions)

Group	1. Control		2. Cerestar		3. Cerestar	
	Declared	Analysed[1]	Declared	Analysed	Declared	Analysed
FUgp/100 kg	115	118	115	119	115	117
Crude protein,%	19.6	20.4	19.8	20.0	19.8	19.8
Crude fat, %	5.6	5.7	5.4	5.5	5.0	4.9
Lysine, g/kg	13.2	13.9	12.9	13.5	13.0	13.2
Methionine, g/kg	4.1	4.2	4.1	3.9	4.1	3.9
Methionine + cystine, g/kg	7.4	7.6	7.8	7.8	7.9	7.7
Threonine, g/kg	8.2	8.5	8.1	8.3	8.2	8.3
Calcium, g/kg[2]	9.2	10.0	9.2	9.9	9.2	9.6
Phosphorus, g/kg[2]	6.2	6.6	6.2	6.5	6.2	6.5
1) Average of four analyses						
2) Average of two analyses						

Appendix 5

Product	**AKV potato protein concentrate (no. 33.000)**
Supplier	AKV Langholt AmbA Gravholtvej 92 9310 Vodskov Denmark **Tel.: +45 96 38 94 20** **Fax.: +45 98 28 65 03** E-mail and homepage: akv@akv-langholt.dk and www.langholt.dk
Content	**AKV potato protein concentrate** is a potato protein concentrate originating from potato starch production. It is rich in protein, with high ileal digestibility of the amino acids. Due to its well balanced amino acid profile it is a suitable substitute for animal protein sources (blood meal, fish meal, milk powder).
Price	**DKK 660 per 100 kg.**

Product	**C*HYPROW 21100**
Supplier	Cerestar Scandinavia A/S Ordrupvej 101, 2nd DK 2920 Charlottenlund Denmark **Tel.: +45 45 46 90 30** **Fax.: +45 45 46 90 40** Web: www.cargill.com
Content	**C*HYPROW** is wheat protein that is obtained during the manufacture of wheat starch. C*HWP 21100 is enzymatic hydrolysed wheat protein. It is a white, creamy coloured fine powder, dispersible in water. It is used as a protein source in milk replacers for calves, lambs, in milk substitute for children and in starter feeds for piglets.
Price	**DKK 590 per 100 kg.**