

Normal and light weight oats as feed for growing pigs

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Abstract The feed value for pigs of five lots of oats was studied by digestibility and feeding trials. Two of the oats were very light (36-39 kg/hl), three normal weight (51-56 kg/hl).

The most apparent difference between the light and normal oats was the contents of starch and crude fibre and the digestibility of NFE. Clear differences were also found in the colours of meals, although all oats were light-coloured varieties. The difference in the energy value between the best and the poorest was 13% by the digestibility and 15% by the feeding trial. The difference in the economic return on the oats was 23%. The energy values of the three normal oats were very much alike.

One of the two light oats was darker in colour and poorly palatable due to damage during harvest. Its energy value was found lower in the feeding trial than in the digestibility trial.

Our results show that light weight oats, if not damaged, are useful feed for pigs, even though their nutritive values are lower. The feed value of damaged oats, on the other hand, could not be predicted from the chemical composition, nor sufficiently even from the results of the digestibility trial.

Introduction

Although oats are not suitable as the sole cereal feed for growing pigs, a certain amount is generally incorporated into the pig rations in Finland.

The nutritive value of oats is more variable than that of barley due to the greater variation in the contents of hulls and starch (SALO 1978a). The different growth conditions in various parts of Finland accentuate the quality variation (VARIS et al. 1979).

The feed value of oats is principally determined by the proportion of hulls (THOMKE 1960, SIBBALD and PRICE 1977), which in composition are equal to rough straw and thus not utilizable by pigs. Oats rich in hulls have a lower digestibility of NFE, because the NFE of such oats contains less starch and more hemicellulose and lignin. The pigs digest the starch of oats totally, but scarcely one third of the hemicellulose (SALO 1971).

The purpose of this experiment was to study the significance of volume weight as a parameter for the nutritive value of oats for growing pigs. The intention was that the oat lots differ evenly in volume weight, but re-testing revealed that two of the five lots were very light, the other three normal. The experiments were performed as a digestibility trial in the Department of Animal Husbandry, and as a feeding trial at the Swine Research Station.

1. Digestibility experiment

Materials and methods

The same five oat lots (Table 1) were used in the digestibility and feeding trials. The oats were milled using a 3 mm sieve.

The digestibility trials were carried out with six castrated Yorkshire pigs, weighing 55–80 kg. A vermicide was administered before the trial. The experiment was performed using a total collection method, as two 3×3 Latin square (one barley sample as the sixth feed). The preliminary period was 12 days for the first trial and 7 days thereafter. The collection period was 5 days.

A spray-dried skim milk powder was used as protein supplement for 16 % of the diet (120 g DCP/F.U.). Minerals and vitamins were given according to standards.

The daily rations of the three periods were 2.4; 2.6 and 2.6 F.U./d (F.U. = 0.7 kg starch). The animals were fed twice daily. Oats, skim milk powder and mineral and vitamin mixtures were weighed separately and given mixed with two volumes of water. The pigs ate the ration immediately and were then offered water.

The faeces and urine were collected in the morning and samples of fixed amount were taken for analysis. The faeces samples were preserved frozen during the period. At the end of the period, splatterings of feed were collected from a plastic sheet placed in front of the trough, and subtracted from the total amount of feed given.

The dry matter determinations were made at 103°C, and the samples for analysis dried in vacuum at 40–50°C. Feeds and faeces were milled using a sieve of 0.5 mm.

The common feed analyses were made according to standard procedures. The starch was determined by amyloglucosidase method (SALO and SALMI 1968).

The digestibility coefficients for skim milk powder were taken from Feed Tables (ERIKSSON *et al.* 1972). The digestibility of oats was then calculated by subtraction. The metabolizable and net energy values were calculated using factors and models of NJF's Feed Tables (ANON. 1969). The results were tested by one-way variance analysis and the differences between means by the Tukey-test.

Results and discussion

The oats formed two groups: the light (under 40 kg/hl) and medium weight (51–56 kg/hl). The clearest difference between the groups was the starch content (Table 1). This was reflected in the digestibility of NFE (Table 2) and proved to be a better parameter for the digestibility of NFE than the crude fibre. The digestibility coefficients of NFE found here agree well with those of oats quality classes 1 and 3 in the Feed Tables (ANON. 1969, ERIKSSON *et al.* 1972).

No significant difference between light and good oats appeared in the crude protein digestibility, or in the nitrogen balances (Table 2). The digestibility of protein tended to increase, however, with both high protein content and high volume weight. The digestibility coefficients for protein were equal to those recorded in some experiments (ANON. 1971, KELLNER and BECKER 1971, SALO 1971, ANDERSON *et al.* 1978), but a little higher than the figures presented in most Feed

Table 1. Varieties, volume weights (85 % DM), and chemical compositions (% of DM) of oats.

Variety	Volume weight, kg	% of dry matter					
		Crude protein	Crude fat	Crude fibre	Ash	NFE	Starch
1. Tiitus	36	16.1	6.5	12.7	2.6	62.1	40.6
2. Tiitus	39	11.2	6.2	14.7	3.4	64.5	39.7
3. Reima	51	11.7	6.3	10.1	2.5	69.4	47.7
4. Tiitus	52	13.8	6.0	10.8	2.8	66.6	46.6
5. Ryhti	56	12.6	5.4	10.3	3.0	68.7	49.7

Table 2. Digestibility coefficients and nitrogen balances by pigs.

Oats, No	Digestibility coefficients					N-balances g N/day
	OM	Protein	Fat	Fibre	NFE	
1.	65.8 ^a	79.8	92.5	7.6	71.3 ^c	19.1
2.	63.9 ^{ac}	78.1	91.8	13.5	70.2 ^c	19.6
3.	73.1 ^{bd}	80.4	92.3	7.1	79.8 ^d	20.3
4.	74.2 ^{bd}	85.5	93.0	15.0	79.8 ^d	21.4
5.	74.6 ^{bd}	81.7	92.6	15.9	80.7 ^d	19.5

Significance of differences in all Tables: $P < 0.05 = a, b$;
 $P < 0.01 = c, d, e$

Table 3. Energy and DCP values for pigs (calculated to 87 % DM content).

Oats, No	MJ ME/kg	Kg/F.U. ¹⁾	DCP, g/kg
1.	10.71 ^a	1.21 ^a	112 ^c
2.	10.22 ^{ac}	1.25 ^{ac}	76 ^c
3.	11.69 ^{bd}	1.10 ^{bd}	82 ^c
4.	11.82 ^{bd}	1.09 ^{bd}	103 ^d
5.	11.74 ^{bd}	1.09 ^{bd}	90 ^d

¹⁾ F.U. = 0.7 kg starch

Table 4. Daily gain, feed conversion and carcass quality of pigs fed different kinds of oats.

Oats, No	1	2	3	4	5
Volume weight, kg	36	39	51	52	56
Daily gain, g, weeks 1-10	752	761	812	800	816
Daily gain, g, whole period ¹⁾	—	690 ^c	775 ^d	756 ^d	771 ^d
Kg feed/kg gain	—	3.40 ^c	2.95 ^d	3.02 ^d	2.97 ^d
Loss at slaughter, %	—	31.3	30.2	30.7	30.3
Side fat, mm	—	11.8 ^a	13.8 ^{ab}	14.7 ^b	13.9 ^{ab}
Firmness of backfat (9-15)	—	10.4	11.4	11.6	11.8
Meat in valuable cuts, %	—	84.4	82.3	81.8	82.8

¹⁾ The final weight corrected according to a 28 % slaughter loss.

Tables. The same could be noted also for the fat digestibility. The pigs digested fat and protein of oats better than those of barley (SALO 1978b).

The digestibility of crude fibre was small and dependent on the individual pig. The level was the same as earlier found for the cellulose of oats (SALO 1971).

The differences between energy values were principally dependent on the digestibility. Between the two light oats, however, the chemical composition was more determinative. The difference between the best and the poorest oats was 13 %.

The energy values found here agree well with values calculated from the digestibility coefficients of oats of like crude fibre contents given in Feed Tables (ANON. 1969, ERIKSSON *et al.* 1972). The only apparent exception is the oats No 1, for which the fibre content predicts too high an energy value. Starch seems again to be a better parameter than fibre.

2. Feeding experiment

Material and methods

The experiment was performed with the same five oat lots as the digestibility trial (Table 1). Sixteen pigs for each oats lot were fed individually from 24.5 kg to 90 kg liveweight gain. (Oats No 1 was sufficient only for eight pigs up to a ten weeks period).

Each oat lot was fed as equal daily dry matter rations. As a protein supplement each pig received 100 g soya bean meal plus 100 g fish meal daily. The digestible crude protein content of the diet was thus at least 15.5 % at the beginning and 9.3 % at the end of the trial (169–107 g DCP/F.U.). The purpose was to give so high a protein supplement that the different protein contents of individual oat samples could not influence the growth rate of animals. The minerals and vitamins were supplied according to standards.

Results and discussion

The growth results (Table 4) agreed well with those of the digestibility trial, that is, the feed efficiency (kg feed/kg again) of oats No 2 was 15 % and the growth rate 11 % lower compared with the best oats. The difference in the economic returns on the oats was still higher (23 %), however, because the light oats required a longer feeding period. Nevertheless it should be emphasized, that even with oats as light as 39 kg/hl the growth rate of pigs was nearly 700 g per day. The results found here agree well with an earlier trial (ALAVIUHKOLA 1978) where two lots of oats were compared, one weighing 45 kg/hl, the other 53 kg/hl. In that trial the difference between the feed efficiency was 11 % and the daily gain 8 %.

The oats of lot 1 were sufficient only for a ten-week trial. The growth results were clearly worse than the digestibility results, due to the damage to the crops at harvest time. The dark colour and poor palatability are indicative of such damage. All the oats were light-coloured varieties, but even so there were clear colour differences, as the reflectometer values of meals below indicate. (A reflectometer measures the intensity of light reflected.) The colour seems to correspond rather well to the feeding values.

Oats, No	Reading of reflectometer
1	48
2	66
3	78
4	77
5	83

The daily intake of the No 1 oats was lower than the others, which explains the poorer growth rate. In the digestibility trial this factor had no effect, because the pigs were larger and the amount of feed was adjusted according to the palatability of the poorest oats.

We would conclude that although volume weight is not an accurate criterion for the energy value, it does offer a practical tool for the rough division of oats into different classes. The starch and crude fibre determinations provide a more reliable basis for this classification. On the other hand the chemical composition does not reveal the possible harvesting damage to crops, and just that may quite decisively affect the nutritive value. To some extent such damage can be judged from the appearance and the palatability of the oats.

The protein value of the oats, for its part, generally correlates positively with the energy value. This rule has exceptions, however, one example being the oats No 1 of the present study.

References

- ALAVIHKOLA, T. 1978. Vihjeitä sikaloille katoviljasta. *Lihantuottaja* 8/1978: 23–32.
- ANDERSON, D.M., BELL, J.M. & CHRISTISON, G.I. 1978. Evaluation of a high-protein cultivar of oats (Hinoats) as a feed for swine. *Can. J. Anim. Sci.* 58: 87–96.
- ANON. 1969. NJF's Fodermiddeltabel. 40 p. Gjøvik.
- ANON. 1971. NATIONAL ACADEMY OF SCIENCES – NATIONAL RESEARCH COUNCIL. 1971. Atlas of nutritional data on United States and Canadian feeds. NAS-NRC, Washington, D.C. (Ref. Anderson et al. 1978).
- ERIKSSON, S., SANNE, S. & THOMKE, S. 1972. *Fodermedlen*. 251 p. Borås.
- KELLNER, O. & BECKER, M. 1971. *Universal-Futterwerttabellen*. 77 p. Hamburg–Berlin.
- SALO, M.-L. 1971. Inverkan av havremjölets finhetsgrad på dess smältbarhet hos svin. NJF-Kongressen 29. juni–2. juli 1971. *Seksjon V*. p. 113–114.
- 1978a. Relationships between physical and chemical characteristics and calculated metabolizable energy value in barley and oats with highly variable volume weights. *J. Scient. Agric. Soc. Finl.* 50: 276–284.
 - 1978b. Hehtolitrapainon ja lajikkeen vaikutus ohran rehuarvoon sikojen ruokinnassa. Abstract: Effect of the volume weight and variety on the nutritive value of barley by pigs. *J. Scient. Agric. Soc. Finl.* 50: 285–290.
- SALO, M.-L. & SALMI, M. 1968. Determination of starch by the amyloglucosidase method. *J. Scient. Agric. Soc. Finl.* 40: 38–45.
- SIBBALD, I.R. & PRICE, K. 1977. True and apparent metabolizable energy values for poultry of Canadian wheat and oats measured bioassay and predicted from physical and chemical data. *Can. J. Anim. Sci.* 57: 365–374.
- THOMKE, S. 1960. Studies on the digestibility of oats by pigs. *Kungl. Lantbr.högsk. Ann.* 26: 269–288.
- VARIS, E., PIRILÄ, O., HUTTUNEN, R., TUPAKKA, K. & LALLUKKA, U. 1979. Kauran laadun vaihtelusta Suomessa. *Hels. Yliop. Kasvinviljelytiet. lait. Julk.* 4. 85 p.

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Kevyt ja normaalipainoinen kaura lihasikojen rehuna.

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Viiden kauraerän arvoa lihasikojen rehuna tutkittiin sulavuus- ja kasvatuskokeella. Kauroista kaksi oli hyvin kevyttä (36–39 kg/hl), kolme normaalipainoista (51–56 kg/hl). Kevyistä kauroista vain toinen riitti täysimitaiseen kasvatuskokeeseen.

Kevyet kaurat poikkesivat normaalipainoisista eniten tarkkelys- ja kuitupitoisuudessa ja sulavuuden puolella typtettömien uuteaineiden sulavuudessa. Myös jauhojen väri vaihteli rehuarvon mukaisesti, vaikka kaikki olivat vaaleakuorisia lajikkeita. Ry-eroksi parhaan ja huonoimman välillä todettiin sulavuuskokeessa 13 % ja kasvatuskokeessa 15 %. Sikojen "maksaman" hinnan ero oli 23 %. Kolmen hyvän kauran rehuyksikköarvossa ei ollut oleellista eroa.

Kevyistä kauroista toinen oli väristä ja huonosta maittavuudesta päätellen kärsinyt korjuuvaurioista. Kasvatuskokeessa sille saatiin huonompi rehuarvo mitä sulavuuskoe ja rehuanalyysi osoittivat.

Kokeen tuloksista voidaan päätellä että kevytkin kaura käy sikojen rehuksi, jos se on tervettä, niinpä kokeessa päästiin 39 kg/hl -painoisella kauralla lähes 700 gramman päiväkasvuun. Tällaisesta kaurasta kannattaa kuitenkin maksaa vain noin 3/4 hyvän kauran hinnasta. Jos taas kaura on kärsinyt korjuuvaurioista, ei rehuanalyysi eikä edes sulavuuskoe ilmaise sen rehuarvoa riittävän hyvin.