

# A COMPARATIVE INVESTIGATION ON THE USE OF RAPESEED OIL AND SOYBEAN OIL IN THE FEEDING OF SWINE

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In some animals the digestibility of rapeseed oil seems to be exceptionally low as compared with that of other edible oils. In experiments with rats DEUEL et al. (3, p. 308) observed that the digestibility percentage of crude rapeseed oil was only 77 and that of refined oil 82. CARROL (1, p. 202) reports the digestibility percentage 58 from experiments with rats and rabbits, and 61 from experiments with guinea pigs. According to ROINE and UKSILA (6, p. 11) the digestibility of rapeseed oil is dependent on the age of the rats being lowest in young rats and increasing with age. In man very high figures for the digestibility of rapeseed oil have been obtained. HOLMES (ref. DEUEL, 2, p. 147) reports a value of 99 % and DEUEL et al. (4, p. 369) have arrived at the same figure. In their experiments with swine PALOHEIMO and JAHKOLA (5, p. 212) could notice no marked difference in digestibility percentages between rapeseed oil and soybean oil the percentages in both cases being about 100.

Some investigations on rats (ref. ROINE and UKSILA 6, p. 1) indicate that rapeseed oil and erucic acid, the main fatty acid of the rapeseed oil, may even cause metabolic disorders. The experiments related below were made in order to study whether rapeseed oil, in spite of its normal digestibility, could have an inhibiting effect on the growth of young swine. In addition attention was paid to the food and water consumption and the quality of carcasses.

## *Arrangement of the experiments*

*1st experiment.* — After a period of preparative feeding 12 pigs which belonged to 3 different litters were chosen for the experiment. Of these animals 2 groups, R and S, were formed, R referring to rapeseed oil and S to soybean oil. The 3 litters were equally represented in each group. Three of the animals in each group were females

and 3 castrated. At the end of the preparative period the age of the youngest animals was 76 days and that of the oldest 82 days. The weight of the animals in group R varied from 22.4—34.8 kg the average being 27.8 kg. In group S the corresponding figures were 22.2—32.8 and 27.5.

During the preparative period the pigs were gradually accustomed to the oil feeding. They received a mixture of rapeseed oil and soybean oil. Then followed a 27 days period in which the principle of restricted feeding was followed. Each group was kept in a large box the front of which was divided into 6 separate small eating cribs with a trough in each. The pigs had access to the cribs only during meal times. However, two of the cribs were open also between feeding times and the troughs in them were filled with water. During this period of restricted feeding it was planned to give to each of the 10 animals daily as much food as the one with the weakest appetite had eaten on the preceding day. As the two smallest pigs in each group consumed considerably less food than their group fellows, they were fed from the 5th day of the period as sub-groups Rb and Sb. The other animals formed the sub-groups Ra and Sa.

The pigs were fed with a concentrate mixture which consisted of 35 % maize meal, 35 % wheat bran, and 30 % skim milk powder. For each kg concentrate mixture 150 g oil and 1.5 kg water were added. Rapeseed oil was given to groups Ra and Rb, and soybean oil to groups Sa and Sb. The Food Unit value (Scandinavian) of the whole food mixture was 1.30 per kg and the percentage of digestible crude protein 14.3. The share of oil in the net energy content of the mixture was 34.5 % and the share of total fat correspondingly 40.2 %.

The need of A- and D-vitamins was satisfied by use of a concentrated A+D-vitamin preparation. As at the end of the preparative period symptoms of parakeratosis were noticed in all groups,  $ZnCl_2$  solution was added to the diet during the experimental periods. The parakeratosis was cured and the animals remained healthy during the rest of the experiment.

After the period of restricted feeding followed a 34 day period of *ad libitum* feeding. In other respects the feeding remained similar to that of the previous period. The food consumption of the individual animals was controlled during the whole period and the consumption of water during the last 13 days of the experiment separately for groups R and S.

The animals were weighed once a week.

*2nd experiment.* — After the period of preparative feeding 10 pigs belonging to 2 litters were chosen for the experiment. Two groups, R and S were formed. The animals of these groups belonged equally to the two litters. At the end of the preparative period the age of the youngest animals was 59 days and that of the oldest 71 days. Thus the pigs of the 2nd experiment were about two weeks younger than those of the 1st. At the said point of time the weight of the animals in group R varied from 16.0—25.9 kg the average being 21.6 kg. For group S the corresponding figures were 15.2—25.9 and 20.8 kg.

In the keeping and feeding of the animals the same principles as in the 1st experiment were followed. Also the food mixture was the same. As the age difference between the two litters was rather big the animals in both groups were for the

period of restricted feeding divided into two sub-groups, a and b. Thus there were the following groups: Ra, Rb, Sa, Sb. Each sub-group a contained 3 animals and sub-group b 2 animals. At the end of the preparative period the average weights of the animals in different groups were as follows: Ra 25.1 kg, Sa 24.8 kg, Rb 16.3 kg, Sb 16.8 kg.

The period of restricted feeding lasted 34 days and that of *ad libitum* feeding 21 days. The consumption of water was controlled throughout the experiment separately for groups R and S.

The pigs were slaughtered at the close of the experiment and the standard commercial estimation of the carcasses was made.<sup>1</sup> Samples of hams were taken for determinations of water and fat as well as saponification and iodine numbers. Other samples were taken from different organs and tissues and sent to the department of Pathological Anatomy (prof. H. TEIR) for histological examination.

Table 1. Weight development of the pigs in the 1st experiment (kg).

Sign of the pig	Restricted feeding		Ad lib. feeding	
	At the beginning	On the 27th day	At the beginning	On the 34th day
Ra 1	29.0	45.3	45.3	65.0
Ra 2	30.0	48.5	48.5	71.5
Ra 3	32.0	49.3	49.3	69.5
Ra 4	36.0	51.8	51.8	73.5
Average Ra	31.8	48.7	48.7	69.9
Rb 1	23.5	38.3	38.3	56.5
Rb 2	25.0	41.0	41.0	63.0
Average Rb	24.3	39.7	39.7	59.8
Average R	29.3	45.7	45.7	66.5
Sa 1	28.0	47.0	47.0	70.5
Sa 2	29.0	45.7	45.7	66.5
Sa 3	32.0	48.0	48.0	71.0
Sa 4	34.0	51.0	51.0	71.0
Average Sa	30.8	47.9	47.9	69.8
Sb 1	23.3	36.0	36.0	59.0
Sb 2	25.7	40.0	40.0	60.0
Average Sb	24.5	38.0	38.0	59.5
Average S	28.7	44.6	44.6	66.3

<sup>1</sup> This estimation was made by J. PARTANEN, M.S. from the Pig Husbandry Experiment Station.

Table 2. Weight development of the pigs in the 2nd experiment (kg).

Sign of the pig	Restricted feeding		Ad lib. feeding	
	At the beginning	On the 34th day	At the beginning	On the 21st day
Ra 11	29.3	48.5	48.5	63.0
Ra 12	30.0	52.5	52.5	70.5
Ra 13	31.5	54.0	54.0	72.0
Average Ra	30.3	51.7	51.7	68.5
Rb 11	19.5	40.0	40.0	57.5
Rb 12	19.5	39.5	39.5	55.0
Average Rb	19.5	39.8	39.8	56.3
Average R	26.0	46.9	46.9	63.2
Sa 11	29.5	52.5	52.5	72.5
Sa 12	30.5	51.0	51.0	76.5
Sa 13	31.0	54.5	54.5	75.0
Average Sa	30.3	52.7	52.7	74.7
Sb 11	20.0	43.5	43.5	67.0
Sb 12	23.0	47.0	47.0	69.0
Average Sb	21.5	45.3	45.3	68.0
Average S	26.8	49.7	49.7	72.0

### Results and Discussion

Tables 1 and 2 show the weight development of the pigs. Tables 3 and 4 give the average food consumption per pig per day in the different sub-groups and groups. Table 5 shows the average weight increment per day per animal, and the consumption of Food Units per kg weight increment.

The results shown in the Tables indicate that there may be a slight difference between rapeseed oil and soybean oil in their effects on swine. During the restricted feeding the weight increment of the animals was almost the same irrespective of the kind of oil received in the food. During the *ad libitum* feeding in the second experiment the animals receiving soybean oil showed a better appetite than their mates which received rapeseed oil. Correspondingly also the weight increment of the former group was greater. In the first experiment, however, such a difference was hardly noticeable.

As mentioned above, in the 1st experiment the consumption of drinking water was controlled for all the groups during a 13 day period. During this time the animals of group R consumed 5.5 kg water per day per animal the corresponding figure for group S being 4.5 kg. The total water consumption (drinking water + the water

Table 3. Food consumption in Food Units per day per pig in different groups of the 1st experiment.

Sub-group or group	Restricted feeding 27 days	Ad lib. feeding 34 days
Ra	1.75	3.02
Rb	1.41	2.44
R	1.64	2.83
Sa	1.75	3.17
Sb	1.37	2.77
S	1.62	3.04

Table 4. Food consumption in Food Units per day per pig in different groups of the 2nd experiment.

Sub-group or group	Restricted feeding 34 days	Ad lib. feeding 21 days
Ra	2.12	3.23
Rb	1.69	3.10
R	1.94	3.18
Sa	2.19	3.93
Sb	1.72	3.63
S	2.00	3.81

Table 5. Weight increment per day per animal, and the consumption of Food Units per kg weight increment.

Group	Weight increment, kg., per day per animal		Food Units per kg. weight increment	
	Restricted feeding	Ad lib. feeding	Restricted feeding	Ad lib. feeding
1st experiment				
R	0.586	0.743	2.80	3.81
S	0.568	0.775	2.85	3.92
2nd experiment				
R	0.597	0.795	3.25	4.00
S	0.654	1.061	3.06	3.59

Table 6. Water consumption in the 2nd experiment, kg per day per animal, and per Food Unit.

Group	Restricted feeding			Ad lib. feeding		
	Drinking water	Total water	Total water per F. U.	Drinking water	Total water	Total water per F. U.
R	3.82	6.21	3.20	4.55	8.36	2.63
S	3.07	5.55	2.78	4.21	8.80	2.31

Table 7. Figures pertaining to the commercial evaluation of the carcasses. (Average figures for groups R and S of the 2nd experiment.)

Group	Slaughter weight kg	Loss in weight at slaughter, %	Thickness of back fat cm	Distribution of back fat, points
R	46.4	25.5	2.6	10.3
S	54.4	24.8	3.2	10.1

Table 8. Data concerning the chemical composition and fat quality of the samples taken from the carcasses. (Average figures for groups R and S in the 2nd experiment.)

Group	In adipose tissue		In meat beneath the fat layer		Saponification number	Iodine number
	Water %	Fat %	Water %	Fat %		
R	10.9	81.8	68.1	8.3	187	85.3
S	10.5	81.6	66.2	9.5	190	96.7

consumed with food) was in group R 8.7 kg and in group S 7.9 kg per day per animal. The water consumption per Food Unit was, correspondingly, 3.1 kg and 2.5 kg. The consumption of drinking water was, on every controlled day, considerably greater in group R than in group S. The variation per pig in the figures in the former group was 4.9—6.0 kg and in the latter 3.7—4.9 kg.

In the 2nd experiment the consumption of drinking water was controlled for all the groups during the whole experiment. Table 6 shows some average figures pertaining to the water consumption in the 2nd experiment. The difference in the water consumption seems to be caused by the difference in the diet.

In the 1st experiment during the last 13 days when the consumption of the drinking water was controlled the rapeseed oil pigs consumed clearly more water than their mates, and in the 2nd experiment, where the water consumption was controlled during the whole experiment, the consumption of total water was slightly greater in the soybean oil group during the *ad libitum* feeding. The consumption of total water calculated per Food Unit in the rapeseed oil group of the 2nd experi-

ment was during both periods greater than in the soybean oil group. The fact that the water consumption of the experimental animals during the 1st experiment was in general greater than during the 2nd experiment evidently depends upon the higher temperature in the barn during the 1st experiment.

Table 7 shows some figures pertaining to the commercial evaluation of the carcasses.

The average figures of the results of the chemical analyses are given in Table 8. The variation of the saponification number in group R was 186—189 and of the iodine number 75.8—91.1. For group S the corresponding variations were 188—191 and 94.9—98.8.

In the histological examination of the organs and tissues no difference between the R and S animals could be detected. However, harmful effects of too great a share of fat in the diet in general could be detected in all experimental animals.<sup>1</sup>

### Summary

For the purpose of comparing the effects of rapeseed oil and soybean oil on the weight increment and thriving of young pigs two experiments were performed. The first experiment was made with 12 and the second with 10 pigs divided into two groups, groups R receiving rapeseed oil and groups S receiving soybean oil in their food. The share of added oil in the net energy content of the food mixture was 34.5 %. Each experiment was divided into a period of restricted feeding and a period of *ad libitum* feeding. During the restricted feeding no marked differences between the two groups could be noticed, but during the *ad libitum* feeding in the second experiment the animals of group S showed a better appetite and a more rapid weight development than their mates in group R. In addition, there was a difference in the consumption of drinking water between the two groups in each experiment. The animals of groups R consumed more water than their mates. In the investigation of the bodies after slaughtering no differences were noticeable between the groups.

<sup>1</sup> The results of the histological investigations are to be published separately in the near future by P. ROINE, E. UKSILA, H. TEIR and J. RAPOLA.

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## SELOSTUS:

## VERTAILEVA TUTKIMUS RYPSIÖLJYN JA SOIJAÖLJYN VAIKUTUKSESTA SIKOJEN RUOKINNASSA

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*Yliopiston kotieläintieteen laitos ja Yliopiston ravintokemian laitos*

Muulla suoritettut tutkimukset ovat osoittaneet, että rypsiöljy eräitten eläinlajien ravintoon lisätynä ei ole samanarvoinen muihin kasvirasvoihin verrattuna. Rotilla, kaniineilla ja marsuilla suoritetuissa kokeissa sen sulavuus on osoittautunut melkoisesti huonommaksi kuin muiden kasviöljyjen. Lisäksi eräissä rotilla suoritetuissa kokeissa on ilmennyt, että rypsiöljyllä on suoranaisia normaalista aineenvaihduntaa häiritseviä vaikutuksia. Näiden vaikutusten katsotaan johtuvan erukahaposta, jota rypsiöljyn rasvahapoista on n. 50 %.

PALOHEIMON ja JAHKOLAN suorittamissa kokeissa (5) ilmeni, että rypsiöljym ruoansulatuksellinen hyväksikäyttö oli 100-prosenttinen. Käsillä olevan tutkimuksen tarkoituksena oli selvittää, olisiko rypsiöljyllä tästä huolimatta huonompi vaikutus sikojen painonlisäykseen kuin erukahappovapaalla kasviöljyllä. Vertailuöljyksi valittiin soijaöljy. Tutkimus jakautui kahteen erilliseen kokeeseen. Kummassakin kokeessa oli öljylisäyksen osuus rehuannoksen nettoenergiasisällössä 34.5 %. Toisessa näistä kokeista osoittautuivat vertailtavien öljylajien vaikutukset eläinten ruokahaluun ja painonlisäykseen miltei samanlaisiksi, mutta toisessa kokeessa oli soijaöljyä saaneiden eläinten ruokahalu parempi ja painonlisäys jonkinverran suurempi kuin rypsiöljyä saaneiden. Kummassakin kokeessa kävi ilmi, että rypsiöljyä saaneet porsaat kuluttivat juomavettä enemmän kuin vertailueläimet. Ruhojen laatuominaisuuksissa ei havaittu eroja eri ryhmien kesken. Myöskin kudossyräyan jodiluku ja saippuoitumisluku olivat rypsiöljyä saaneilla eläimillä samaa suuruusluokkaa kuin vertailueläimillä.