Class FH sunflower seeds (*Helianthus annuus*) as an energy/protein source for early weaned piglets

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The digestible energy (DE) content of milled and whole class FH sunflower seed (SS) was determined in a digestion trial and found to be respectively 18,7 and 9,9 MJ/kg on an air dry basis. Two diets for early weaned piglets formulated to be equal in protein, lysine and DE and respectively containing 18,0% roasted full-fat soybean meal (RSB) or 19,3% SS were evaluated in a digestion trial. The diets were also fed to piglets, weaned at 3 weeks of age (16 per diet), for a period of 36 days. The SS-based diet had a DE content of 15,1 MJ/kg air-dry matter and the RSB diet 14,6 MJ/kg air-dry matter. No significant differences were found in the performance of the piglets on the two diets. It was, however, observed that piglets fed the SS-based diet tended to perform slightly better, which can be ascribed to the higher DE content of the SS diet. It, therefore, appears that SS can be used effectively as a protein/energy source in diets for early weaned piglets.

Die verteerbare-energie(VE)-waarde van gemaalde en heel klas-FH-sonneblomsaad (SS) is in 'n verteringstudie onderskeidelik as 18,7 en 9,9 MJ/kg lugdroë materiaal bepaal. Twee vroegspeendiëte wat onderskeidelik 18,0% geroosterde volvet sojabone (RSB) en 19,3% SS bevat het, saamgestel om ekwivalente proteien-, lisien- en VE-inhoude te bevat, is in 'n verteringstudie geëvalueer. Die diëte is daarna elk vir 'n periode van 36 dae aan 16 varkies, wat op 3-weke-ouderdom gespeen is, gevoer. Die SS-gebaseerde dieet het 'n VE-inhoud van 15,1 MJ/kg lugdroë materiaal en die RSB-dieet 'n VE-inhoud van 14,6 MJ/kg lugdroë materiaal gehad. Geen betekenisvolle verskille in prestasie is egter tussen die varkies op die twee diëte gevind nie. Varkies wat die SS-gebaseerde dieet ontvang het, het wel geneig om beter te presteer, wat moontlik aan die hoër VE-waarde van die dieet toegeskryf kan word. Dit blyk dus dat SS doeltreffend as energie-/proteïenbron in vroegspeendiëte van varkies aangewend kan word.

Keywords: Sunflower seeds, piglet, early weaning

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Introduction

Since the 1967/68 production season a high oil content class FH sunflower seed (SS) has been the predominant type commercially available in South Africa. It is by far the most important oil seed crop used mainly as a source of domestic oil in South Africa (Abstract of Agricultural Statistics, 1987). Also, SS can be produced in large areas of South Africa because of its short growing season and drought resistance.

No treatment is needed before feeding SS to pigs (Adams & Jensen, 1985a) and it contains no anti-nutritional components (Miller & Pretorius, 1985). Although SS has been successfully used in diets for growing pigs (Cook & Dinusson, 1881 ; Dinusson, Johnson, Harold & Zimprich, 1982; Marchello, Cook, Slanger, Johnson, Fisher & Dinusson, 1983 and Marchello, Cook, Johnson, Slanger, Cook & Dinusson, 1984) some of the results are conflicting. Adams & Jensen (1984) found that the young pig is able to make good use of the oil in SS. In studies using only SS, Adams & Jensen, (1985b) determined a digestible energy (DE) value for pigs. However, on an air-dry basis the SS used by them contained only 36% oil which is considerably lower than the average oil content of 43,1% reported for South African class FH SS (Oilseeds Board, 1985). This higher oil content may have an effect on the DE value of the seeds.

The use of roasted full-fat soybeans (RSB) as an energy/protein source for early weaned piglets has been successfully used under local conditions (Viljoen, Kemm & Ras, 1984). Apart from the heat treatment required, a necessity when RSB is fed, soybeans require appreciably better growth conditions than SS. Sunflower seed is easily available and is more manageable for the farmer to use in the feeding of his pigs. The high energy requirements of the early weaned piglet necessitates the inclusion of a high energy source, which is not always readily available. Adams & Jensen, (1984) found that SS can be used as effectively as RSB to increase the energy value of pig diets.

The high oil content in SS can cause rancidity if stored over long periods in a milled form. The pig's ability to utilize whole seeds must therefore be investigated as the use of whole seeds would not only simplify management, but could also save on milling costs.

This study was conducted to determine the nutrient content of SS and to compare the performance of piglets fed SS both whole or milled as an alternative to RSB in a standard diet for early weaned piglets (Viljoen, *et al.*, 1984).

Materials and Methods

A consignment of class FH sunflower seed was obtained from the South African Oil Seeds Board.

Experiment 1

Chemical composition

A representative sample of the SS was analysed for crude protein (Macro Kjeldahl on the Büchi apparatus), crude fibre (AOAC, 1984 on the Fibertec apparatus), ether extract (Soxlet on the Soxtec apparatus), methionine and cystine (Dennison & Gous, 1984) and lysine (Beckman, 1969). The conversion factor used for calculatlng crude protein was: $\%N \times 5{,}30$ (Pellett & Young, 1980).

Digestion trial

Eighteen pigs (nine gilts and nine boars) of 32,1 ± 2,2 kg live mass, divided into three groups of six pigs (three of each sex) were used. A control diet (Table 1) as used by Siebrits & Ras (1981) was fed to the first group at a rate of 1500 g of air-dry meal per day in two equal portions at 08h00 and 15h00. The diets fed to the other two groups were made up of 80% control diet plus 20% SS in whole or milled forms. Gilts were fitted with 18 Ch Bardex Foley catheters in order to separate urine from faeces.

Table 1 Percentage composition of the control diet (Siebrits & Ras, 1981) used in Experiment 1[a]

Maize meal	(%)	77
Fish meal	(%)	11
Wheaten bran	(%)	10
Bone meal	(%)	1
Salt	(%)	1
Vitamins and minerals		+
Crude protein	(%)	16,49

[a] On an air-dry basis

The pigs were subjected to a 14-day trial period consisting of a 7-day preliminary and a 7-day collection period during which faeces were collected in metabolism crates. Details of the procedures followed in collecting and analysing the faeces samples were described by Siebrits & Ras (1981). The energy content of the feed and faeces samples was determined using an adiabatic bomb calorimeter. The substitution method as used by Siebrits & Ras (1981) was used to calculate the DE values and the DM and energy digestibilities of the whole and milled SS.

Experiment 2

Digestion trial

Twelve pigs (six boars and six gilts) of 69,4 ± 2,3 kg live mass were used. Six pigs per diet were fed the diets in Table 2 at a rate of 1750 g of air-dry meal per day. The procedures followed were similar to those described in Experiment 1.

Table 2 Percentage composition of diets fed in Experiment 2

		RSB diet	SS diet
Component			
Maize meal	(%)	58,5	53,9
Sunflower seed meal	(%)	—	19,3
Full fat soybean meal	(%)	18,0	—
Fish meal	(%)	8,3	13,5
Wheaten bran	(%)	12,8	11,5
Synthetic lysine	(%)	0,2	0,3
Feed lime	(%)	1,0	0,3
Salt	(%)	1,0	1,0
Anti-oxidant	(ppm)	250	250
Vitamins and minerals		+	+
Theoretical composition[a]			
Protein	(%)	20,3	20,3
Digestible energy	(MJ/kg)	14,5	14,5
Lysine	(%)	1,2	1,2
Fibre	(%)	4,2	5,6
Fat	(%)	6,8	11,7

[a] On an air-dry basis

Growth trial

Thirty-two piglets weaned at 3 weeks of age (16 per diet) were randomly allotted to the two experimental diets (Table 2). Piglets were kept in groups of two in flat deck type cages (1,5 × 1,0 m) with perforated metal floors equipped with self-feeders and automatic water nipples. The piglets had *ad lib* access to their specific diets and clean water at all times. Feed intake and live mass were recorded every 4th day for 36 days. Feed and water were not withdrawn before weighing. One-way analyses of variance were used to determine statistical differences between treatment growth parameters.

Results

Experiment 1

Chemical composition

The nutrient content of the SS determined by chemical analyses was as follows: dry matter 94,8%; crude protein 17,29%; fat 45,8%; crude fibre 14,6%; lysine 0,62%, and methionine plus cystine 1,02% (on an air-dry basis).

Digestion trial

From the data in Table 3 the DE values (MJ/kg air-dry matter) and DM and energy digestibility (%) of the whole and milled SS were calculated. The calculated values are presented in Table 4.

When SS was fed in the milled form compared to the whole form, the DM digestibility of the SS increased from 40,7% to 73,3% and energy digestibility from 25,3% to 74,5%. Hence the air-dry DE content of SS was 9,9 MJ/kg for the whole seed and 18,7 MJ/kg when milled.

Table 3 DM and energy digestibility data (means ± *SD*) for 18 pigs fed either a control diet or the control diet substituted with 20% whole or milled class FH sunflower seed (SS) (Experiment 1)

Component	Control diet	80% Control + 20% whole SS	80% Control + 20% milled SS
DM content (%)	90,76	91,90	91,57
DM-intake (g/day)	1361 ± 0,3	1378 ± 0,2	1371 ± 5,1
GE-intake (MJ/day)	25,7 ± 0,01	28,3 ± 0,01	27,7 ± 0,10
DM digestibility (%)	86,4 ± 1,0	77,2 ± 1,5	83,8 ± 2,2
Energy digestibility (%)	85,5 ± 1,1	73,5 ± 1,9	83,4 ± 2,7
DE (MJ/kg air-dry material)	14,7 ± 0,2	13,9 ± 0,4	15,4 ± 0,5

DM — Dry matter; GE — Gross energy; DE — Digestible energy

Table 4 DM and energy digestibility values for whole and milled SS calculated from the data presented in Table 3

Component	Whole SS	Milled SS
DM content (%)	90,8	94,9
DM digestibility	40,7	73,3
Energy digestibility (%)	25,3	74,5
DE (MJ/kg air-dry material)	9,9	18,7

Experiment 2

Although the diets in the growth trial (Table 2) were formulated to be equal in DE content (14,5 MJ/kg air-dry matter) the data obtained in the digestion trial (Table 5) showed that the SS-containing diet had an air-dry DE content of 15,1 MJ/kg and the RSB-containing diet 14,6 MJ/kg, the difference being statistically significant ($P \leq 0,05$).

The performance data of the piglets summarized in Table 6 show only small insignificant differences between piglets fed the diets containing RSB or SS.

Table 5 Digestibility data and DE content (means ± *SD*) for 12 pigs (six per diet) fed the RSB and SS diets set out in Table 2 (Experiment 2)

Nutritive parameter	RSB diet	SS diet
DM content (%)	90,64	91,85
DM intake (g/day)	1581 ± 3,47	1570 ± 8,74
GE intake (MJ/day)	31,5 ± 0,07	32,4 ± 1,80
Nitrogen intake (g/day)	39,0 ± 0,09	37,3 ± 2,08
DM digestibility (%)	81,5 ± 1,89	80,2 ± 1,50
Energy digestibility (%)	80,6 ± 2,18	79,4 ± 1,77
Protein digestibility (%)	83,7 ± 2,13	85,1 ± 1,80
DE (MJ/kg air-dry material)	14,6 ± 0,39	15,1 ± 0,34[a]

[a] Significantly different ($P \leq 0,05$)

Table 6 Performance data (means ±*SD*) for 32 piglets (16 per diet) fed the RSB and SS diets set out in Table 2 (Experiment 2)

Performance parameter	RSB diet	SS diet
Initial mass (kg)	5,4 ± 0,91 (100)	5,4 ± 0,96 (100)
Final mass (kg)	17,5 ± 2,50 (100)	17,8 ± 3,65 (102)
Average daily gain (g/day)	377 ± 46,8 (100)	391 ± 73,9 (104)
Total feed intake (kg)	19,1 ± 3,04 (100)	19,5 ± 3,97 (102)
Total DE intake (MJ)	278 ± 44,2 (100)	294 ± 59,7 (106)
Feed conversion (kg feed/kg gain)	1,59 ± 0,14 (100)	1,57 ± 0,10 (99)
DE conversion (MJ DE/kg gain)	23,1 ± 2,10 (100)	23,6 ± 1,44 (102)

Piglets fed the SS diet tended to perform slightly better, but with a slightly worse DE conversion ratio (23,6 MJ/kg gain vs. 23,1 MJ/kg gain).

Discussion

Experiment 1

The average chemical composition of South African class FH SS for the 1983/84 production season (on an air-dry basis) was: 94,7% dry matter; 18,0% protein; 43,1% oil, and 13,5% crude fibre (Oilseeds Board, 1985). The SS used in the present study contained 4% less protein; 6% more fat and 8% more crude fibre. The values found in this study are nevertheless well in the range of maximum and minimum values for South African Class FH SS.

The air-dry composition of SS has been reported by a number of authors (Dinusson, *et al.*, 1982; Kepler, Libal & Wahlstrom, 1982 and Adams & Jensen, 1985b). The reported fat content of SS varies from 36% (Adams & Jensen, 1985b) to 41% (Dinusson, *et al.*, 1982). These values are lower than the value found in this study (45,8%) and the average for the 1983/84 production season of 43,1% (Oilseeds Board, 1985). The only available DE value for SS found in literature was the 17,6 MJ/kg (on an air-dry basis) reported by Adams & Jensen (1985b). The higher DE value of 18,7 MJ/kg air-dry matter found in the present study is probably due to the high fat content (Table 4). The DE content of SS compares favourably with that of a comparable feed ingredient such as full-fat soybean meal. The lysine content of SS (0,62%) is rather low which would necessitate the addition of synthetic lysine to most pig diets containing SS. According to Wahlstrom (1985) this can be done with satisfactory results.

The 44% lower DM digestibility of whole SS (Table 4) suggests that the digestive enzymes were unable to penetrate the hulls of the seeds. According to the Oilseeds Board (1985) the hulls of SS produced in the

1983/84 season contained on average 50,5% fibre (on an air-dry basis). This high fibre content could probably act as a barrier against efficient digestive enzyme penetration. The low DM digestibility resulted in the undesirably low energy digestibility as well as the low DE value of the whole SS.

Experiment 2

Although statistically insignificant, the performance parameters, presented in Table 6, show that piglets receiving the SS diet had a 4% higher average daily gain than piglets fed the RSB diet. This could be ascribed to a 2% higher feed intake and a 6% higher DE intake. Piglets fed the SS diet utilized their feed slightly better (1%) but required more DE per unit of live mass gain (23,6 vs 21,3 MJ/kg gain).

In accordance with Adams & Jensen (1985b) it is therefore obvious that the piglets were able to make efficient use of the abnormally high oil content (11,7% on an air-dry matter basis) in the SS diet. This could possibly be ascribed to a high digestibility of the oil and to direct incorporation of the fatty acids, particularly linoleic acid, into body fat stores (Wood, 1983 and Adams & Jensen, 1985b).

Conclusions

It can be concluded that milled SS with an air-dry DE content of 18,7 MJ/kg can be effectively used to increase the energy density in pig diets. Whole SS is however poorly utilized by piglets. Piglets efficiently utilize the high oil content in SS. Sunflower seeds can therefore be used effectively as an alternative energy/protein source for RSB in diets for early weaned pigs. The low lysine content of the SS must however be taken into account when using milled SS as a dietary ingredient.

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