



The effect of naked oats (*Avena nuda* L.) used in feeding gilts on their sexual activity

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Abstract. The study was carried out on 180 Polish Landrace gilts. Three gilts were selected from each of 60 litters. When their body weight had reached about 30 kg, the gilts were divided into three groups, two experimental and one control, with 60 individuals per group. The mixture fed to the experimental groups contained 40 % (D₁) and 20 % (D₂) naked oats of the Akt variety. Sexual activity was observed in the gilts during the first, second and third oestrus. The occurrence of the standing reflex was tested twice a day, in the morning and afternoon, and its duration was determined by timing the positive reaction to a boar, to touch and to mounting. The first oestrus occurred earliest in the experimental gilts (group D₁) at an average age of 178.2 days, i.e. 8.7 days earlier than in the control group. Analysis of the 17- β -estradiol level in the blood serum of the experimental gilts showed that the feed rations containing naked oats had a beneficial effect on the secretion of this hormone.

1 Introduction

A very important period in the reproductive life of gilts is the onset of oestrus and ovulation, indicating that the gilts have reached sexual maturity. Sexual maturity in gilts can be accelerated and certain disorders eliminated by means of oestrus-stimulating techniques such as an intensive diet high in calories, protein and vitamins; a change of room or pen; contact with a boar; keeping gilts in pens near a boar; the use of pheromones; allowing the gilts to use paddocks; or administering oestrogen (Cronin et al., 1983; Hemsworth, 1987; Levis, 2000; Evans and O'Doherty, 2001; Gordon, 2004; Peltoniemi et al., 2005). A temporary lack of libido and oestrus may be due to a lack of exercise, flaws in the manner in which the animals are kept, and, above all, by quantitative and qualitative nutritional deficiencies (Levis, 2000). Naked oats have higher energy and protein value than other grains considered to be the best for feeding monogastric animals (Petkov et al., 2001). The amino acid composition of oat protein is beneficial because the content of almost every exogenous amino acid is higher than that found in wheat (Kosieradzka and

Fabijańska, 2001). In naked oats there is a predominance of globulin in comparison to prolamin and glutenin. Naked oats have exceptionally high fat content, from 6 to 10 % d.w. (Piech et al., 2003; Pisulewska et al., 2011). The lipid composition of naked oats has a predominance of unsaturated fatty acids (UFAs), which account for over 80 % of the fat (Pisulewska et al., 1999). Compounds with powerful antioxidant properties have been identified in oat lipids (Peterson, 2001). Studies by Stasiak et al. (2000) and Mazur and Stasiak (2006) showed that feeding with mixtures containing naked oats had a beneficial effect on reproductive performance indicators in gilts and sows.

The aim of the study was to determine the effect of naked oats used in feed rations for gilts on their sexual behaviour.

2 Material and methods

The study was carried out on 180 Polish Landrace gilts kept on a breeding farm. Three gilts, with body weights of about 30 kg, were selected from each of 60 litters. They were as-

Table 1. Composition of mixtures for gilts.

Feed (percentage)	13–20-week-old gilts			20–26-week-old gilts		
	D ₁	D ₂	K	D ₁	D ₂	K
Naked oats meal	40.00	20.00	–	40.00	20.00	–
Wheat meal	–	20.00	40.00	–	20.00	40.00
Barley meal	37.35	37.30	37.25	42.35	42.30	42.25
Soybean meal	20.00	20.00	20.00	15.00	15.00	15.00
2-Ca phosphate	0.90	0.90	0.90	0.90	0.90	0.90
Fodder chalk	1.30	1.30	1.30	1.30	1.30	1.30
Premixture L-lysine 50 %	0.20	0.25	0.30	0.20	0.25	0.30
NaCl	0.25	0.25	0.25	0.25	0.25	0.25
Contents per 1 kg of mixture						
EM MJ	13.04	12.90	12.76	13.04	12.90	12.82
Crude protein (g)	169.30	168.44	167.58	155.45	154.59	154.08
Crude fat (g)	40.21	30.35	20.49	40.11	30.26	20.36
Lysine (g)	9.20	9.19	9.18	8.19	8.10	8.15
Methionine+cystine (g)	5.84	5.74	5.63	5.48	5.38	5.29
Ca (g)	8.32	8.37	8.42	8.16	8.20	8.27
P (g)	6.15	6.06	5.97	6.05	5.96	5.87
Na (g)	1.21	1.20	1.19	1.19	1.18	1.17

Table 2. Composition of mixtures for gilts.

Feed (percentage)	Gilts		
	D ₁	D ₂	K
Naked oats meal	40.00	20.00	–
Wheat meal	–	20.00	40.00
Barley meal	48.50	48.45	48.40
Soybean meal	9.00	9.00	9.00
2-Ca phosphate	0.90	0.90	0.90
Fodder chalk	1.30	1.30	1.30
Premixture L-lysine 50 %	–	0.05	0.10
NaCl	0.30	0.30	0.30
Contents per 1 kg of mixture			
EM MJ	13.03	12.89	12.75
Crude protein (g)	138.03	137.18	136.32
Crude fat (g)	39.98	30.17	20.32
Lysine (g)	5.98	5.97	5.96
Methionine+cystine (g)	5.06	4.95	4.84
Ca (g)	7.69	7.73	7.78
P (g)	5.73	5.64	5.55
Na (g)	1.37	1.36	

signed to one of three groups, two experimental and one control, with 60 individuals in each.

The gilts were fed complete mixed rations in amounts consistent with the norms given in “Swine Feeding Standards” (Normy Żywienia Świń, 1993). The mixture fed to the experimental groups contained 40 % (D₁) and 20 % (D₂) naked oats of the Akt variety. The composition and nutritional value of the mixtures is presented in Tables 1 and 2, adopting the

values given in “Swine Feeding Standards” (1993) for barley, wheat and post-extraction ground soymeal. The chemical composition of naked oats was determined before the experiment on the animals was begun. The following were determined in the samples:

- content of crude protein, ether extract, crude ash and crude fibre according to AOAC (2000);
- content of mineral nutrients Ca and Na by atomic absorption spectroscopy (ASA) and total phosphorus according to Fiske and Subbarow (1925);
- protein amino acid content by ion-exchange chromatography in an automatic amino acid analyser;
- fatty acid composition by gas chromatography using a chromatograph (Varian GC3800, Varian Inc., Walnut Creek, CA, USA).

Sexual activity was observed in the gilts during the first, second and third oestrus. The occurrence of the standing reflex was tested twice a day, in the morning and afternoon, and its duration was determined by timing the positive reaction to a boar, to touch and to mounting. The intensity of oestrus symptoms was evaluated according to the scale developed by Stasiak (1996):

3 points – the gilts are very calm, manifest oestrus very clearly, react to the boar and to the mounting attempt for about 30–35 s;

2 points – the gilts are calm, manifest oestrus clearly, react to the boar and to the mounting attempt for about 20–25 s;

Table 3. Age at each oestrus and sexual activity of gilts.

Experimental groups	Age at the first oestrus occurrence (days)	Sexual activity during the first oestrus (pts)	Age at the second oestrus occurrence (days)	Sexual activity during the second oestrus (pts)	Age at the third oestrus occurrence (days)	Sexual activity during the third oestrus (pts)
D ₁	178.2 ^{A,a} ± 8.32	2.2	199.0 ^{A,a} ± 8.33	2.5	219.9 ^A ± 8.48	2.6
D ₂	182.1 ^{A,b} ± 9.53	2.1	203.2 ^{A,b} ± 9.29	2.4	224.5 ± 9.40	2.4
K	186.9 ^B ± 10.11	2.0	208.1 ^B ± 10.47	2.2	229.7 ^B ± 11.58	2.3

^{AB} differences significant at $P < 0.01$; ^{ab} differences significant at $P < 0.05$.

1 point – the gilts manifest oestrus faintly, react to the boar and to the mounting attempt for about 5 s.

After the onset of the second and third oestrus the gilts were weighed and the thickness of the fat layer was measured using a Renco PREG-ALERT apparatus: I – above the scapula; II – behind the last rib 3 cm from the back line; III – behind the last rib 8 cm from the back line; and IV – on the lumbar region. After the standing reflex was identified, blood was collected from the marginal ear vein to determine the level of the oestrus hormone 17- β -estradiol. The concentration of the hormone was determined by radioimmunoassay using a SORIN Biomedica RIA kit (SORIN Biomedica, Milano, Italy). The results obtained were analysed statistically using one-way analysis of variance (group effect). Differences between means were tested by means of Duncan's test.

3 Results and discussion

The first oestrus occurred earliest in the experimental gilts (group D₁) at an average age of 178.2 days, i.e. 8.7 days earlier than in the control group (Table 3). Statistically significant ($P < 0.01$) differences were noted between the experimental groups and the control. These differences also applied to reproductive maturity (the second or third oestrus). In gilts from the experimental groups the second oestrus occurred on average on day 201.1, and the third oestrus on day 222.2. During the first oestrus the gilts exhibited low sexual activity, from 2.0 points in the control group to 2.2 in group D₁. In subsequent oestruses the gilts' sexual activity increased. It was highest in the gilts from group D₁ during the third oestrus, at 2.6 points. Analysis of the 17- β -estradiol level in the blood serum of the experimental gilts showed that the feed rations containing naked oats had a beneficial effect on the secretion of this hormone (Table 4). Its concentration was the highest – 34.1 pg mL⁻¹ – in blood taken from the gilts in experimental group D₁ during the third oestrus of the first reproductive cycle, and lowest – 31.8 pg mL⁻¹ – in the blood of the control gilts entering the second oestrus of the first reproductive cycle. The body condition and fat reserves of gilts at first service influence the length of their reproductive life. The mean thickness of fat tissue was highest in the D₁ gilts, ranging from 1.56 to 1.77 cm depending on the oestrus (sec-

Table 4. Concentration of estradiol in blood serum of gilts in the second (II) and third (III) oestrus.

Oestrus	Group	<i>n</i>	17- β -estradiol, pg mL ⁻¹
II	D ₁	60	33.5 ^A ± 1.82
	D ₂	60	32.9 ^A ± 1.73
	K	60	31.8 ^B ± 1.90
III	D ₁	30	34.1 ^a ± 1.75
	D ₂	30	33.9 ± 1.80
	K	30	33.1 ^b ± 1.79

n: number of evaluated gilts; ^{AB} differences significant at $P < 0.01$; ^{ab} differences significant at $P < 0.05$.

ond or third) (Table 5). These values differed significantly ($P < 0.01$) from the thickness of the fat layer in the control.

A very important problem in reproduction is the failure of females to manifest their readiness and ability to copulate, which delays the age at which the first oestrus occurs. Gilts attain sexual maturity at the age of 5–7 months, depending on genetic and environmental factors. Sinclair et al. (2001) report that Swedish Landrace gilts attain sexual maturity at the age of 173 days. According to Klocek (1997), sexual maturity is attained earliest by gilts kept in groups and allowed to use a paddock (183 days), and latest in those housed individually with no paddock (198 days). Reproductive maturity in gilts depends on body weight and on the degree of development of the reproductive system, and is closely linked to the maturation of a certain number of ovarian follicles and distinct manifestation of oestrus (Stasiak, 1996; Rekiel, 2002). Thus the results obtained in the present study concerning the age at which the first oestrus occurred can be considered optimal. The addition of naked oats to the feed rations led to earlier oestrus in the gilts and had a beneficial effect on their sexual maturity (the occurrence of the second and third oestrus). The gilts' sexual activity depended on the proportion of naked oats in the diet and increased in successive oestruses. The gilts from the experimental groups clearly manifested oestrus and reacted longer to the boar and the mounting attempt.

The level of 17- β -estradiol intensifies symptoms of oestrus, during which oestrogen attains its highest level in the

Table 5. Backfat thickness in gilts during the second and third oestrus.

Oestrus	Group	n	Backfat thickness (cm)				
			Measurement 1	Measurement 2	Measurement 3	Measurement 4	Mean of 4 measurements
II	D ₁	60	2.19	1.64	1.28	1.12	1.56 ^A ± 0.32
	D ₂	60	2.06	1.47	1.16	1.02	1.43 ± 0.29
	K	60	1.93	1.41	1.08	0.98	1.35 ^B ± 0.28
III	D ₁	30	2.36	1.91	1.46	1.33	1.77 ^A ± 0.41
	D ₂	30	2.31	1.68	1.32	1.17	1.62 ± 0.38
	K	30	2.06	1.54	1.23	1.13	1.49 ^B ± 0.33

n: number of evaluated gilts; ^{AB} differences significant within groups of gilts in the second or third oestrus at $P < 0.01$.

blood one day before the appearance of external symptoms (Stasiak, 1996; Belstra et al., 1999; Willenburg et al., 2004). The use of naked oats in the gilts' feed caused synthesis of 17- β -estradiol to increase in the gilts; its level was higher than the values obtained in studies by Lechowski (2009) and Stasiak (1996). Oestrogens, including 17- β -estradiol, regulate ovarian activity and have a luteotropic effect. Jiao et al. (1992) found that the content of this hormone in the organism of the sow was correlated with the size of ovulation and the gonadotropin luteinizing hormone surge prior to ovulation.

Feeding gilts with mixtures containing naked oats caused a beneficial increase in the thickness of the fat layer. Many authors (Whittemore et al., 1995; Sinclair et al., 1998) have found that a fat layer whose thickness exceeds 16 mm leads to good reproductive results. High-calorie flush feeding a few days before oestrus appears in gilts has a beneficial effect on the intensity of ovulation (Hoffmann, 1994; Van den Brand et al., 2001).

In conclusion, the use of naked oats in gilts' feed rations was observed to have a beneficial effect on their sexual activity and fat cover. Gilts from the experimental groups fed mixtures with 40% (D₁) and 20% (D₂) naked oats attained sexual and reproductive maturity at a statistically significantly earlier age, and very distinctly manifested oestrus in comparison with the control group.

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