Use of the “dynamic effect” of flushing to increase the fertility rate of ewes from Pleven Blackhead breed

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INTRODUCTION

By abundant feeding during the breeding season, known in the international literature as “flushing”, the number of ovulated ova and respectively the fertility rate of ewes could be increased (Nottle et al. 1990; Vinoles, 2003; Scaramuzzi et al., 2006). In recent years the effect of flushing was fully detailed. It includes the so called “static”, “dynamic” and “immediate or acute” effects. For the first time, a classification for the influence of flushing over the reproductive performance of ewes was made by Smith & Stewart (1990). The "static” effect is connected with good body condition score (BCS) regardless of when it was achieved. The "dynamic effect" is associated with an increase in the number of ovulated ova through abundant feeding and improvement of live weight and body condition score in the last 3-4 weeks before insemination (Landau & Molle, 1997; Scaramuzzi et al., 2006). "Acute" is the effect of a higher nutrient (mainly protein and fat) intake focused in the second part of the oestrous cycle (Pearse et al., 1994; Bomfim et al., 2014).

In our previous experiments we have studied the effect of focused (acute) feeding in partially synchronized ewes through the “ram effect” (Nedelkov et al., 2012; 2013). By a proper application of a synchronization plus focused feeding an insemination of approximately 80% of available ewes within two weeks was achieved (Nedelkov et al., 2013). In the present experiment we used the “dynamic” flushing effect by applying a longer abundant feeding in order to check the possibility for increase of the fertility rate in cases where there is no proper application or there is a lack of synchronization of oestrous by hormonal or non-hormonal methods.

The aim of the present study was to determine the effect of 2-week extensive feeding, so called “dynamic flushing effect”, on the fertility rate of ewes from Pleven Blackhead breed.

Material and Methods

The experiment was conducted in 2013 with 164 Pleven Blackhead ewes aged 2.5 to 8.5 years (inseminated for the second to the seventh time) owned by the Institute of Forage Crops - Pleven. The animals from one of the flocks were divided into a control group of 82 ewes and experimental group (82 ewes) in which an extensive feeding for two weeks was applied. Both groups were equalized by age and fecundity from the previous lambing. The animals were reared in the same grazing conditions. During the insemination, all sheep were milked.

Apart the daily grazing, the two groups of sheep were supplemented with a daily amount of 300 g barley two months prior to and during the artificial insemination. An additional (plus 300 g barley) daily feeding with 500 g whole pea (DM 87.6%, CP 25.7%) was applied to the experimental group for two weeks including the period of 7 days before and 7 days after the start of insemination The concentrate was given twice daily – in the morning at 6.00 AM and in the evening at 5.00 PM during the milking.

The artificial insemination was performed by the 8th day after whole pea supplementation to the ration of experimental group and continued 28 days. The ewes in oestrus were detected by 5 teaser rams equipped with aprons to prevent breeding. Teasers were placed in the two groups of ewes in the morning and evening for one and a half hour each time. After the end of artificial insemination stud rams were placed in the flock for natural mating of ewes in oestrous. The ID numbers of ewes in heat and inseminated sheep and dates of lambing of all sheep were recorded on a daily basis. The aborted ewes and death cases were also recorded.

The five-point scale of Todorov et al. (1994) assessed the body condition score of all sheep subject to artificial insemination. BCS and live weight were assessed twice, at the beginning of the experiment and two weeks later, after the end of abundant feeding with whole pea.

The statistical significance of the differences between control and experimental groups was determined by $\chi 2$ (chi square test) by Plohinskiy (1980). The data about live weight and BCS were processed by one-way analysis of variance (ANOVA).

Results and Discussions

The artificial insemination continued four weeks from 08.08.2013 to 05.09.2013. During that period which coincided with the natural breeding period of Pleven Blackhead ewes, 91.5% of ewes from the flushed group and 96.3% of ewes from the control group respectively were artificially inseminated (Table 1).

Table 1. Artificially inseminated (AI) ewes during 4 weeks period.

Group	1st-15th day after introduction of rams and AI	16th-28th day after introduction of rams and AI (“ram effect”)	Total
Percentage of all sheep in the group*			
Flushed	43.9	47.6	91.5
Control	51.2	45.1	96.3
Total	47.6	46.4	94.0

*The differences between groups were not statistically significant (P>0.05).

It is known that the contact with rams at the end of anestral period after a period of their separation from ewes, results in a relatively synchronized manifestation of oestrous, a phenomenon known in the literature as the "ram effect” (Pearce & Oldham, 1984; Ungerfeld, 2003). The „ram effect” usually occurs in two peaks between 16th – 28th days after the contact with rams (Delgadillo et al., 2009; Bedos et al., 2010). At this experiment the typical “ram effect” was not observed and the number of ewes in oestrous in the first 15 days after contact with teaser rams and also in the next 14 days was practically equal (Table 1). In previous studies of ours, conducted with different sheep breeds, apart the two “ram effect”- specific peaks, small peaks were also observed between the 9th and the 13th day after the contact with rams (Nedelkov et al., 2011; Nedelkov et al., 2012a). Furthermore, in the experiment with same sheep breed where the ewes were not inseminated in the first 15 days after contact with rams, we recorded a higher second peak of ewes having responded to the “ram effect” (Nedelkov et al., 2013). This peculiarity of response to the “ram effect” was associated with a significant percentage of ewes in oestrous during the first 15 days after the contact with rams. It should be remembered that in experiments conducted at the beginning of natural breeding period as this experiment, the response to the "ram effect" is complicated by the presence of spontaneously ovulating ewes (Chemineau et al., 2006).

Table 2. Changes in body condition score (BCS) and live body weight after applied extensive feeding of experimental flushed group for 2 weeks.

	Before extensive feeding*		After extensive feeding	
	Body condition score	Live weight, kg	Body condition score	Live weight, kg
Experimental group	2.94±0.44	59.47±5.95	3.11±0.45	60.83±5.67
Control group	2.93±0.27	58.78±4.88	2.91±0.32	58.45±4.76

*The differences in BCS and live weight, before and after extensive feeding, were not statistically significant (P<0.05).

The data in Table 2 indicate a slight increase of BCS and live weight in the experimental flushed group. Even though insignificant, the increase of both indicators was mainly due to the "dynamic effect" of applied extensive feeding.

In the present experiment statistically significant increase of the biological and farm economic (industrial) fecundity at the experimental flushed group was observed, by 16.7% and 14.7% respectively (Table 3). The biological fecundity represents the number of born live and dead lambs per 100 lambed ewes. The farm economic (industrial) fecundity is associated with the number of born live lambs per 100 ewes in the flock, in this case in the group. The observed difference in the fecundity could be explained by the "dynamic effect" of flushing applied to the experimental group. This effect was associated with an increase of leptin and insulin in a positive balance of energy in the body, and increased glucose utilization (Allen et al., 2009). It is considered that those changes directly affect the ovaries and lead to increased folliculogenesis and number of ovulated ova (Scaramuzzi et al., 2006). Moreover, it changed the hepatic metabolism of steroids and caused a disruption of feedback between ovaries and hypothalamo-pituitary system (Parr et al., 1993). There is no data about a specific stimulating impact over the hypothalamo-pituitary system (Wade and Jones, 2005).

Table 3. Lambing data.

Parameters	Control group		Flushed group	
Number of sheep	82	%	82	%
Dead pregnant, number	0	0	1	1.2
Aborted sheep, number	2	2.4	1	1.2
Barren sheep, number	6	7.3	7	8.6
Lambed sheep, number	74	90.3	73	89.0
Live lambs born, number	84 a		96 b	
Stillborn lambs, number	2 a		1 a	
Number of born alive and dead lambs	86 a		97 b	
Biological fecundity*, %	116.2 a		132.9 b	
Industrial fecundity**, %	102.4 a		117.1 b	

[a, b, c] Different superscripts between the two columns for a given indicator indicate differences significant at P<0.05.

* Live and stillborn lambs per 100 lambed ewes.

** Farm industrial fecundity = live born lambs per 100 ewes in a farm (group).

On the other hand, a short extensive feeding applied during the second half of the oestrous cycle is able to increase the number of ovulated ova (Vinoles et al., 2005). In another experiment with the same sheep breed where we used the “acute or immediate effect” of flushing, a slight increase in the fecundity was observed, but the main reason for this was the different BCS, which was lower in the flushed group (Nedelkov et al., 2013). During the present experiment we applied an extensive feeding for a longer period – one week before and one week after the start of artificial insemination. Considering that a high percentage of the ewes were inseminated, both during the first 15 days after the contact with rams, and within the two peaks typical for the “ram effect” (Table 1), we could accept that the applied 14 days of extensive feeding in most ewes coincided with the second half of the oestrous cycle. This fact suggests that in the present experiment the "dynamic effect" of flushing was complemented by the “acute or immediate” effect of focused flushing.

The influence of an even slight increase in BCS and live weight (Table 2) should not be ignored as its effect on sheep reproduction has been described by many authors (Rondon et al., 1996; Gottardi et al, 2014). Ewes with a higher BCS have a higher level of ovulation, which is accompanied by higher levels of FSH and lower estradiol levels as compared to animals with low BCS (Vinoles et al., 2005). The decrease in estradiol levels is possibly related to the higher levels of leptin in ewes with more body fat (Forcada & Abecia, 2006). In several experiments, the authors found that leptin inhibits the *in vivo* secretion of estradiol and stimulates folliculogenesis through the follicular phase of oestrous cycle (Kendall et al., 2004; Scaramuzzi et al., 2006). By studying the "static" and "dynamic effect" of flushing which are associated with an increase in BCS, Scaramuzzi et al. (2006) emphasized the key role of leptin system. It is known that the more the fat reserves in the body, the higher the blood concentration of leptin (Blache et al., 2000).

Therefore, in this experiment the “acute effect” of focused flushing in combination with changes in the BCS and live weight led to the recorded increase in the fecundity of the group flushed with whole pea ration. In this case we can assume that the combination of these two factors led to a significant increase in the fecundity of ewes as a result of extensive feeding – flushing.

CONCLUSIONS

Extensive feeding with 500 g whole pea plus 300 g barley, for two weeks at the beginning of the natural breeding period of ewes with BCS approximately 2.9 resulted in higher number of born (live and stillborn) lambs per 100 lambed ewes (so called biological fecundity) by 16.7%. It was also achieved a higher number of born live lambs per 100 ewes in a farm (so called farm economic or industrial fecundity), by 14.7%.

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