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Comparative Study of Two Methods of Induction of Estrus and Fertility Following Artificial Insemination in Azawak Zebu in Niger

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Abstract: A comparative of two induction methods of estrus induction and fertility has been carried out on 28 females Azawak zebu in Niger. This study mains chiefly and identifying the most effective method for better inseminations. The females have been divided into two sets following two intra-vaginal devices used. Two sub-sets of 7 females have been formed according to the PMSG dose associated with the treatment. Two inseminations have been carried out. The results are as follows: response to the induction: PRID®, 57.14%; CIDR-B®, 61.53%. Fertility rate: PRID®, 28.57%; CIDR-B®, 38.46%. There has been no significant difference to the estrus induction and fertility, between the PRID® and the CIDR-B® synchronization. Since the two methods virtually lead to the same response rate, the stock breeder can choose one of the methods depending on the cost and by paying attention to the feeding and less stressful factors.

Key words: Estrus, induction, insemination, fertility, Azawak Zebu, Niger.

1. Introduction

In Niger, a cattle breeding is nowadays one of the pillars of the country's economy. It contributed to nearly 11% of the GDP (gross domestic product) and 30% of agriculture's GDP in 2006 [1]. Cattle breeding significantly contribute to the budget of households (up to 15%) and meeting food needs for up to 25% [1].

The livestock (cows) is estimated at 7,336,088 cows and consists of five breeds. Among those breeds, the Azawak zebu is the most important in number and in dairy production.

Despite this number, the livestock is characterized by a lower productivity with regard to the breeding conditions that are often difficult (deficient diet, pathological issues) and by a lower genetic potential.

The population's needs in terms of dairy products are not met due to the lower productivity of local breeds and the rapid population growth.

As a result, improving the productivity becomes a goal to achieve in order to meet the population's needs animal products on one hand and to improve the incomes of farmers and cattle breeders on the other hand.

In order to overcome this problem, it is necessary to introduce reproductive biotechnologies, namely the artificial insemination. The efficient use of this technique requires a control of sexual cycles of the different breeds. Therefore, there is a need to develop some estrus induction procedures that are suitable to local breeds.

The current project, which is part of the first

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artificial insemination tests on the Azawak zebu, aims at comparing the effectiveness of heat induction and the fertility after inducting the two methods with intra vaginal devices: spiral PRID ® (Progesterone Releasing Intra vaginal Device) and CIDR-B ® (Control Internal Drug Releasing). These methods are combined with different doses of PMSG (Pregnant Mare Serum Gonadotropin).

2. Materials and Methods

2.1 Materials

The experiment was done in August 2009 at the Sahelian Experimental Station of Toukounous (SEST) located at 200 km north of Niamey (latitude N 14°31', longitude 8°18'). It is a dairy oriented station. The climate is Sahelian with an average rainfall of 300 mm per year, an average temperature of 34 °C with the lowest temperatures ranging from 10 °C to 20 °C in December and January and the highest temperatures from 40 °C to 45 °C in May and June.

The animals have been divided into herds based age, sex, physiological condition. They live on the natural pasture land of the station. They have been vaccinated and dewormed at the beginning of the rainy season against symptomatic coal, anthrax coal and pasteurellosis.

The experimental herd consisted of 28 females Azawak breed. All of them had at least 60 days for the postpartum period. They were all suckling and milked twice a day.

2.2 Methods

Synchronization and artificial insemination

Initially, the operation involved 28 females divided into two (2) sets based on the devices (14 females per device (PRID® or CIDR-B ®). For each device two (2) sub-sets of 7 females were formed based on the dose of PMSG (350 IU or 400 IU (International Unit)).

The following procedure was used.

- Jo: installing PRID® and CIDR-B ®
- J7: 500 μg cloprostenol injection (2 mL of oestrumate) IM (Intra Muscular).
- J9: PRID ®/CIDR-B ® removal and IM injection of 350 IU or 400 IU of PMSG depending on the group.

A female lost her CIDR-B ® before the removal and was excluded from the whole group.

Heat controls have been performed after removing the devices every morning at the milking area from 8 am to 12 pm and evening from 4 pm to 6 pm. A female is in heat when it accepts to be mounted on by others or when it has cervical mucus during inseminations.

The first insemination has been performed on all the females 48 h after the removal of intra-vaginal devices. The second insemination has been carried out 24 h after the first.

Pregnancy diagnosis

Pregnancy diagnosis has been performed through rectal fingering 3 months after the artificial insemination.

2.3 Statistical Tests

X2 test has been used to compare induction rates, and fertility rates based on the type. The data was processed in Minitab 14. The significance level was 5%.

3. Results and Discussion

3.1 Results

3.1.1 Response to Heat Induction

At the end of induction treatment we have the response rates of females per dose of PMSG respectively in Tables 1-3 based on method of treatment and their reaction. There were females that displayed estrus behavior by immobilization for stud or that had a silent heat detected through the presence of cervical mucus during the insemination. There were 4 cases of silent heat out of the 16 events (25%). The overall response rate was 59.25%.

Statistical analyses showed that the PMSG dose parameter, the type of induction treatment had no

Table 1 Response rates based on PMSG dose.

Response to induction	Dose PMSG		Total
	350 IU	400 IU	
In heat	7	9	16
Not in heat	7	4	11
Total	14	13	27
Response rate	50%	69.23%	59.25%

$X^2 = 1.03$; $P = 0.31$.

Table 2 Response rates based method.

Response to induction	Method of treatment		Total
	PRID®	CIDR-B®	
In heat	8	8	16
Not in heat	6	5	11
Total	14	13	27
Response rate	57.14%	61.53%	59.25%

$X^2 = 0.054$; $P = 0.81$.

Table 3 Response rates based on PMSG dose and treatment method.

Dose PMSG	Method of treatment		Response rate based on PMSG dose
	PRID®	CIDR-B®	
350 IU	57.14% (4/7)	42.85% (3/7)	50% (7/14)
400 IU	57.14% (4/7)	83.33% (5/6)	69.23% (9/13)
Response rate based on method	57.14% (8/14)	61.53% (8/13)	Average rate 59.25% (16/27)

Table 4 Pregnancy rates based on PMSG dose.

Fertility	Dose PMSG		Total
	350 IU	400 IU	
Pregnant	4	5	9
Not pregnant	10	8	18
Total	14	13	27
Pregnancy rate	28.57%	38.46%	33.33%

X^2 =0.29; $P = 0.58$.

Table 5 pregnancy rates based on treatment method.

Fertility	Method of treatment		Total
	PRID®	CIDR-B®	
Pregnant	4	5	9
Not pregnant	10	8	18
Total	14	13	27
Pregnancy rate	28.57%	38.46%	33.33%

$X^2 = 0.29$; $P = 0.58$.

significant effect ($P > 0.05$) on the response to induction.

The probabilities obtained were respectively $P = 0.31$, $P = 0.81$.

Table 6 Pregnancy rates based on PMSG dose and treatment method.

Dose PMSG	Method of treatment		Pregnancy rate by dose
	PRID®	CIDR-B®	
350 IU	14.28% (1/7)	42.28% (3/7)	28.57% (4/14)
400 IU	42.85% (3/7)	33.33% (2/6)	38.46 (5/13)
Pregnancy rate based on treatment	28.57% (4/14)	38.46% (5/13)	33.33% (9/27)

3.1.2 Post Induction Fertility

Tables 4-6 show the pregnancy rates obtained after rectal fingering three months after the artificial insemination. Due to the fact that early pregnancy diagnosis has not been performed 3 weeks after the insemination, there is missing information on the actual fertility of this experimental herd because of possible embryonic mortalities that have not been estimated.

The X2 test that was used showed neither the PMSG dose factor nor the treatment factor had a significant effect on the fertility of the herd ($P > 0.05$).

3.2 Discussion

Many reproductive issues are due to the difficulties encountered in detecting heat. The external outward signs of estrus are generally very mild, and it has been difficult to observe within a short time period. The average response to estrus induction (59.25%) that we have found is lower than the rates found in other suckling zebu in Cameroon (78-98%) using other progestagens, (norethandrolone and fluorogestone acetate) and other PMSG doses (600-800 IU) [2]. Zecchini and others [3] found lower rates (29.7%) on Azawak breed in intensive livestock using Crestar. In Senegal, Bouyer [4] obtained on other breeds better rates (92.78%) after synchronization with PRID®: on N'Dama and 92.92% on Gobra.

On Azawak zebu, inducting estrus with PRID® or CIDR-B® does not show any significant difference in fertility after the insemination if the PMSG doses vary between 350 and 400 IU.

However, there is a slight advantage for using 400

IU: 69.23% induction rate versus 50% for 350 IU; 38.46% pregnancy rate for 400 IU versus 28.57% for 350 IU. This is likely due to the use of higher doses of PMSG, which explains the difference between our results and those found by Lhoste and others [2], but the risks of having twin are high [5]. Other induction tests and insemination using PRID® and 400 IU PMSG permitted to have about 20% of super ovulation on another zebu breed (Djelli) that resulted in twin pregnancies.

The Azawak zebu would probably be less sensitive to PMSG stimulation than the Djelli zebu. In fact, the PMSG has a longer mid-life, and an overdose can cause some disruptions in folliculogenesis [6].

But doses of PMSG can not explain by itself the differences in female fertility. No matter that the conditions might be: natural mating or artificial insemination, the fertility of an animal largely depends on the fertility of its partner [7]. Thus our results are influenced by both the effect of the semen and the intrinsic effect of the female. Besides the quality of the semen, there are the technical nature of the inseminator and the time of the insemination. Among the effects of the female we have the diet, embryonic mortality and hormonal issues related to the sexual cycle [5, 8, 9].

In the conditions of our experiment, two major factors have contributed to inhibit estrus expression and the lower fertility. (1) The diet, several studies have reported a negative role of malnutrition regarding the response to estrus induction [10, 11]. The herd used in the experiment lived exclusively on poor pasture. It has been a difficult transition period between the dry season and the rainy season. (2) Lactation: our sample entirely consisted of suckling cows that were milked twice a day in the presence of their calves. Several studies have shown that the presence of the calf and milking can delay or inhibit estrus [10, 12, 13].

Calving season may also have an influence on the recovery time of ovarian activity [14]. 25% of cows under heat are not externalized estrus, probably due to physiological reasons related to the inadequate hormonal secretions [10, 15] or social reasons. It has been shown that in a herd, social hierarchy plays a role on estrus expression; cows that are aggressive are generally not mated with others, [16]. A factor that is not to be underestimated estrus expression and fertility is animal stress during the test. Our sample was stressed by their sudden split from their calves and the herd after milking; the distance to reach the corridor and blood draw to which they are subjected to once per day.

4. Conclusions

From the results of this test, we can conclude that it is possible to select one of the two procedures of synchronization. The results are not significantly different from a physiological point of view, so the choice of the procedure will mainly be based on the cost. It is possible to improve the results of estrus induction and fertility by paying special attention to diet, with appropriate supplements, and by avoiding animal stress. It is not enough to improve the management in order to optimize induction and fertility. Other parameters must also be controlled: semen quality and insemination time which depends on the time of ovulation. Standard times of insemination applied to European breeds can widely vary among zebus in our difficult climate conditions.

These procedures should be improved with other investigations regarding the time of ovulation.

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