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The Relationship of Estrous Character with Conception Rate in Madura Cattle

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ABSTRACT: This study aimed to determine the relationship between estrous characteristics with the success of AI in Madura cattle. A total of 50 female Madura cattle were used in this research. The estrus quality was observed, including vulva temperature, vulva swelling, vulva color, cervical pH, and cervical mucus. The parameters were NRR-1, NRR-2, *Pregnancy Rat*e, and *conception rate*. The results showed that Madura cattle with the quality of estrus in the uneven red vulva color category showed better results than red vulva color at NRR-1, NRR-2, CR, and PR values, 100%, 93,33%, 93,33%, and 93,33% respectively. Abundant cervical mucus showed better results than the moderate mucus on the NRR-1, NRR-2, CR, and PR values, which were 100%, 87,5%, 75%, and 75%, respectively. Then a vulva temperature of 37,0-37,9ºC showed better results than a vulva temperature >38ºC in the NRR-1, CR, and PR values, namely 92,12%, 64,71%, and 70,59. Furthermore, the pH condition of cervical mucus with a pH value of 7 showed better results than cervical mucus with a pH of 8 at NRR-1, NRR-2, CR, and PR, 94,12%, 94,12%, 70,59%, and 76,47%. In the very swollen vulva category, the results were better than slightly swollen at the NRR-1 value of 100%. The NRR-2, CR, and PR scores in the slightly swollen category had better values than in the very swollen category, 85%, 65%, and 72,5%, respectively. This study concludes that the characteristic uneven color of the vulva, the vulva temperature is 37,0-37,9, the abundant cervical mucus, cervical pH 7, and a very swollen vulva give a high percentage of the success of AI.

Keywords: Artificial insemination; Conception rate; Non-return rate; Estrous character; Pregnancy rate.

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INTRODUCTION

Artificial insemination (AI) is one of the reproductive technologies that can improve the genetic quality of cattle (Susilawati, 2019). The AI program can allow farmers to obtain superior bull at a low cost (Wiranto, Susilawati, and Kuswati, 2019). The success of implementing AI is closely related to the reproductive performance of livestock. In addition, the accuracy in detecting estrus in female cows is essential to maximizing livestock reproduction because different characteristics of estrus will affect the success of AI. According to Irvan, Wahjuningsih, and Susilawati (2017), cows will secrete mucus from the cervix that is clear, transparent, and odorless during the estrus phase. The amount and concentration of mucus will change depending on the oestrus cycle passed and the cow's hormonal conditions. The difference in the characteristics of estrous has an authentic influence on the conception rate (CR) value. In conditions of thick mucus, the CR value is 68% (Irvan et al., 2017). This value follows the CR standard for cows, which is 60%.

During the estrous cycle, hormones interact with each other to have a physiological and behavioral impact on the cow (Ramli., Siregar., Thasmi., Ramli., Dasrul., Wahyuni and Sayuti., 2016). In the heat, the color of the vulva is red, while cows that are not in heat have pale vulva. A uniform red color change on the vulva indicates that the cattle are in the estrus phase (Kusuma, Kuswati, Huda, Yekti, and Susilawati., 2021). In addition, a change in the temperature of the vulva can be used as a support in detecting estrus. The temperature of the vulva in estrus generally tends to be higher than the vulva temperature in regular cows (Susilawati, 2019). The reproductive conditions of the female cow cause the temperature difference. If in the peak phase of estrus, the temperature of the vulva is relatively high compared to the other estrus phases. The increase in body temperature is also influenced by hormones secreted during estrus (Sakatani, Takahashi, and Takenouchi., 2016). High estrogen levels in the blood cause the blood supply to the reproductive organs to increase, causing the vulva to swell and the vulva temperature to be high (Kusuma et al., 2021). The characteristics of the estrus in the female cow can determine the success of AI. Therefore, this research will evaluate the estrus character of Madura cattle with the success of AI using a single dose of AI.

MATERIALS AND METHODS

Materials

A total of 50 cows that had good reproductive performance were used in this research. The Females should have BCS 3-6, normal reproductive conditions, and never experience reproductive disorders. The semen used was Madura frozen semen produced by the Artificial Insemination Centre of Singosari, Malang. The data was obtained directly from the farmers' farm in Lenteng District, Sumenep Regency.

Estrous Observation

The estrus condition was determined based on vulva color, cervix mucus, vulva swelling, vagina temperature, and vagina pH. The vulva color was classified as even red and uneven red color (Irfan et al., 2017). The cervix mucus is classified as abundant mucus, moderate mucus, and no mucus. In addition, the temperature of the vulva was measured by using a digital thermometer Thermo One (Onemed, Indonesia). At the same time, the pH was measured with a universal pH indicator strip (Merck, Germany) (Kuswati, 2022). Finally, the amount of swelling in the vulva was carried out using a caliper to measure the width or thickness of the vulva.

Parameters

1. Non-Return Rate

The NRR1 was observed on the 19th to 21st days after insemination to observe other estrus signs in the cows. If the cows did not show estrus signs, it was considered

that the cow was pregnant. However, suppose the cow shows estrus signs on the 19th to 21st days after the insemination. In that case, it indicates that the cow is not pregnant, and the inseminator will apply the second insemination. The NRR2 was observed on the 38th to 42nd days of AI. The non-return rate is the percentage of female cows that do not show signs of estrus after being inseminated in 19-21 and 38-40 days.

$$\text{NRR 1} = \frac{(number\ of\ cows\ that\ are\ not\ in\ estrus)}{(\text{Number of cows inseminated}} \text{ x } 100\%$$

2. Conception rate Susilawati (2011) stated that the CR value could be known by counting the number of pregnant cows in the first AI.

$$\text{CR}=\frac{(\text{Number of pregnant cows in 1st AI})}{(\text{NNumber of cows inseminated})} \text{ x } 100\%$$

3. Pregnancy rate

The pregnancy rate is the percentage of the number of pregnant cows with the total number of cows inseminated (Ansori et al., 2021). The pregnancy rate value is calculated by the formula (Iswoyo and Widyaningrum, 2008):

$$\text{PR}=\frac{(\text{Total Number of pregnant cows})}{(\text{Number of cows inseminated})} \text{ x } 100\%$$

RESULT AND DISCUSSION

Relationship between Vulva Colour with NRR-1, NRR-2, Conception Rate, and Pregnancy rate in Madura Cows

Table 1 shows that the even red vulva category has NRR 1 and NRR 2 values of 91,43% and 80%. While for the characteristics of uneven red color, the NRR-1 and NRR 2 value was 93,33%, respectively.

The results show that the percentage of the NRR-1 and NRR-2 values do not significantly differ. However, there was a decrease in the value of NRR-2 from the percentage of NRR-1. This decrease is due to the different physiological and estrus cycles of livestock. Hisyam et al. (2021) stated that the decrease in the value of NRR 1 and NRR 2 was due to abnormal cycle factors and the estrus phase, which was nearing the end, resulting in low fertilization. In addition, the condition of cows with silent heat can also affect this value.

Table 1. Percentage of Vulva Color to the Value of NRR-1 and NRR-2

Vulva Color	n (%)	NRR-1		NRR-2	
		n	%	n	%
even red color	35 (70%)	32	91,43	28	80,00
uneven red color	15 (30%)	15	100	14	93,33

Table 2 shows that the CR value in the even red color category was 51,43% obtained from the results of pregnant cows in the 1st AI. In comparison, the PR value was 60% because there were 21 successfully pregnant cows out of a total of 35 cows. The calculation of the CR and PR values in the uneven vulva color category were 93,33% and 93,33%, respectively.

There are similarities in the values of CR and PR because, in this category, there were 14 cows that successfully got pregnant in the first AI from 15 cows. There is a significant difference between the CR and PR values for the uniform red vulva and the uneven red color. The CR and PR values in the even red color were between 50-60%, while the CR and PR values in the uneven

red color were above 90%, while a good and ideal CR value is 60%.

Relationship of Cervical Mucus to NRR-1, NRR-2, Conception Rate, and Pregnancy Rates in Madura Cows

Cervical mucus is a fluid in the reproductive organs which usually appears when the cow is estrous. The category of abundant mucus in cows is when the mucus is in many volumes and hangs from the vulva. The moderate category mucus is used if the observations show that there is mucus that presents only a few traces of mucus around the vulva. Then no mucus category is used if there is a dry vulva and no traces of mucus. The results of cervical mucus can be seen in Table 3.

Table 2. Percentage of vulva color to the value of Conception Rate and Pregnancy Rate

Vulva Colour	n (%)	CR		PR	
		n	%	n	%
even red color	35 (70%)	18	51,43	21	60,00
uneven red color	15 (30%)	14	93,33	14	93,33

Table 3. Percentage of Cervical Mucus to the Value of NRR-1 and NRR-2

Cervix Mucus	n (%)	NRR-1		NRR-2	
		n	%	n	%
abundant mucus	8 (16%)	8	100	7	87,50
moderate mucus	21 (42%)	18	85,71	16	76,19
No mucus	21 (42%)	21	100	19	90,48

The results showed that in the category of abundant mucus, the percentage values of NRR 1 and NRR 2 were 100% and 87,5%. Then in the moderate cervical mucus categories, the values of NRR-1 and NRR-2 were 85,71% and 76,19%. Meanwhile, the no mucus category shows that the NRR-1 and NRR-2 values were 100% and 90,48%, respectively. The CR value in the abundant category was 75%, while the PR value was 75%. The CR value in the moderate category was 52,38%, and the PR value was 66,67%. Ovulation in cows occurs in the early metestrus phase, therefore AI should be implemented 8-12 hours after being in heat in cattle. Annashru et al. (2017) mentioned that the right time for implementation of AI is 9-24 hours after the first heat appears. The same thing also resulted from the research of Udin et al. (2016), which stated that the highest pregnancy rate in AI cattle was obtained during the estrus cycle (13-18 hours) at 68,91%, middle estrous (7-12%) then early estrus (0-6 hours)

Table 2. Percentage of Cervical Mucus to the Value Conception Rate and Pregnancy Rate

Cervix Mucus	n (%)	CR		PR	
		n	%	n	%
abundant mucus	8 (16%)	6	75,00	6	75,00
moderate mucus	21 (42%)	11	52,38	14	66,67
No mucus	21 (42%)	15	71,43	15	71,43

Correlation of Vaginal Temperature to NRR-1 and NRR-2, Conception Rate, and Pregnancy Rates in Madura Cows

Vaginal temperature indicators are categorized into 2, medium, and high. The medium category is used if the temperature parameter resulting from the observations ranges from 37,0-37,9 degrees Celsius. In comparison, the high-temperature category is used if the temperature parameter shows a number above 38 degrees Celsius to obtain the following data.

Table 3. Percentage of Vaginal temperature to the Value of NRR-1 and NRR-2

Vaginal temperature	n (%)	NRR-1		NRR-2	
		n	%	n	%
37,0-37,9	17 (34%)	16	94,12	14	82,35
≥38	33 (66%)	31	93,94	28	84,85

The results showed that in the temperature category of 37,0-37,9 degrees Celsius, the NRR 1 value of 94,12%, and the NRR-2 value was 82,35%. In the category of vaginal temperature above 38 degrees, the NRR-1 value is 93,94%. Meanwhile, the NRR-2 was 84,85%, respectively.

Table 4. Percentage of Vaginal temperature to the Value of *Conception Rate* and *Pregnancy Rate.*

Vaginal temperature	n (%)	CR		PR	
		n	%	n	%
37,0-37,9	17 (34%)	11	64,71	12	70,59
≥38	33 (66%)	21	63,64	23	69,70

The temperature category of 37,0-37,9 degrees Celsius shows a percentage of CR value of 64,71% and a PR value of 70,59%. The vulva temperature category of 38 degrees Celsius shows a percentage of CR value of 63,64%. In contrast, the percentage of PR value was 69,70%.

The temperature category of 37,0-37,9 degrees Celsius has a slightly higher success rate for AI than the temperature category above 38 degrees Celsius. This can be seen from the results of the percentage of existing CR and PR values. The CR value at a temperature of 37,0-37,9 shows 64,71%, while the PR value is 70,59%. This value follows the standard CR and PR values in cattle. Ihsan and Wahjuningsih (2011) stated that the ideal CR value is 60%. The CR value in this study is lower than the results of Susilawati's research (2011) which shows the CR value in cattle is 80%.

The high and low values of CR and PR are influenced by several factors, one of which is the condition of estrus when the cow is in AI and the timing of AI. This follows the research conducted by Fernanda, Susilawati, and Isnaini (2013), which stated that the accuracy of estrus detection and the implementation of AI is one the critical factors for the success of AI. the temperature in the female reproductive tract decreases slightly. This decrease can increase spermatozoa's maximum penetration and capacitation in the female reproductive tract.

Relationship of cervical pH to NRR-1, NRR-2, Conception Rate, and Pregnancy Rate in Madura Cows

The pH value is an essential parameter of cervical mucus in sperm transfer into the female reproductive tract (Tsiligiann et al., 2011). pH affects the quality of sperm viability in the cervix. The higher the hormone estrogen in the blood during estrus, the volume of cervical mucus will increase with an increasingly alkaline pH so that it can be used as a reference for the success of AI. The pH indicator was obtained by observing the color on the pH indicator paper inserted into the vagina until it was ˙wet and then compared with the color listed on the pH indicator device. The results of the pH observation table show that the pH category is divided into 2, pH seven, and eight.

The data in the table above shows that in the category of pH seven NRR-1 value is 94,12%, and the NRR-2 value is 94,12%. While in the category of pH eight, the NRR-1 was 93,94%, and the NRR-2 value was 78,79%. Another factor that affects the decrease in the percentage of NRR values is repeat breeders, ovarian disorders such as

persistent corpus luteum, and ovarian hypofunction. Two cows experience this with CLP disorders and four with ovarian hypofunction.

Table 5. Percentage of Vaginal pH to the Value of NRR-1 and NRR-2

Vaginal pH	n (%)	NRR-1		NRR-2	
		n	%	n	%
7	17 (34%)	16	94,12	16	94,12
8	33 (66%)	31	93,94	26	78,79

Table 8. Percentage of Vaginal pH to the Value of Conception Rate dan Pregnancy Rate

Vaginal pH	n (%)	CR		PR	
		n	%	n	%
7	17 (34%)	12	70,59	13	76,47
8	33 (66%)	20	60,61	22	66,67

The cervical pH category 7 shows a percentage of CR value of 70,59% and a PR value of 76,47%. This value was obtained from 12 cows successfully pregnant in the first AI from 17 cows. Then the PR value was obtained from 11 cows that did not experience heat again from 17 that were inseminated.

The pH eight category shows a percentage of CR value of 60,61%, while the percentage of the PR value of 66,67%. This shows that the pH of cervical mucus range 7 has a high NRR value. Rizki et al. (2019) explain that the pregnancy percentage can reach 100% if the pH range is 7,2-7,4.

The Relationship of the Vulva Swelling to NRR-1, NRR-2, Conception Rate, and Pregnancy Rates in Madura Cows.

The swelling category of the cow's vulva was categorized into 2: very swollen and slightly swollen. The results can be seen in Table 9.

Table 6. Percentage of Vulva swelling to the Value NRR-1 and NRR-2

Vulva swelling	n (%)	NRR-1		NRR-2	
		n	%	n	%
Very swollen	10 (20%)	10	100,00	8	80,00
Slightly swollen	40 (80%)	37	92,50	34	85,00

The results showed that the percentage values of NRR 1 and NRR 2 in very swollen were 100% and 80%, respectively. While the slightly swollen category, NRR-1, and NRR-2, are 97,5% and 85%, respectively. The percentage of good NRR values is in the range of 65-75%. A high NRR value has a high chance of higher AI success. The results showed that there is no significant difference between the very swollen category and the slightly swollen category. The category of vulva swelling did not show a significant difference in the resulting NRR value. Changes in the condition of the vulva, such as color and size, are associated with the increased estrogen hormone in estrus conditions. Estrogen stimulates vaginal wall thickening, increased vascularization so that the external genitals are swollen and reddish, and increased vaginal secretions so that mucus is found hanging on the vulva (Baliarti, Priambodo, Ismaya, Budiyanto, and Danang, 2012).

Table 7. Percentage of Vulva swelling to the Value NRR-1 and NRR-2 Conception Rate and Pregnancy Rate

Vulva swelling	n (%)	CR		PR	
		n	%	n	%
Very swollen	10 (20%)	6	60,00	6	60,00
Slightly swollen	40 (80%)	26	65,00	29	72,50

The slightly swollen category had a higher AI success rate than the very swollen category. This can be caused because the vulva is slightly swollen, and the cow has gone through the peak phase of estrous so that when the AI is in the condition, it is close to the ovulation process that occurs in the female cow's reproductive tract. Saputra et al. (2017) stated that high estrogen causes the increased blood circulation in the reproductive organs of female cattle, causing the appearance of the vagina to swell, which causes changes in the vulva gap during oestrus (Baliarti et al., 2019).

CONCLUSIONS

This study concludes that the differences in estrous characteristics will influence the success of AI, including NRR-1, NRR2, Conception Rate, and pregnancy rate value. The characteristic uneven color of the vulva, the vulva temperature is 37,0-37,9, abundant cervical mucus, cervical pH 7, and a very swollen vulva give a high percentage of the success of AI.

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