

## SHORT COMMUNICATION

# Field assessment of a BCS measuring device at timed AI in crossbred dairy cows of Amazonian smallholders

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## ABSTRACT

This study aimed to evaluate the efficiency of a body condition score (BCS) assessment device (BCAD) to identify cows with an adequate BCS and, presumably, a higher fertility when subjected to timed artificial insemination (TAI). We evaluated cows at smallholder dairy farms in the state of Rondonia, Brazil. Crossbred dairy cows (n = 141) were subjected to a TAI protocol and classified according to the BCAD scale as low BCS (red; n = 55) or adequate BCS (green; n = 86). The outcome pregnancy per artificial insemination (P/AI) was analyzed by logistic regression. Cows classified as green by the BCAD had a significantly greater P/AI (41 of 86; 47.7%) than cows classified as red (15 of 55; 27.3%; P = 0.01). In conclusion, the BCS assessment device was an effective tool to detect cows more likely to become pregnant due to their adequate BCS and, consequently, better fertility in TAI.

**KEYWORDS:** fertility, milk, ovulation, pregnancy, Vetscore

## Avaliação em campo de um dispositivo medidor de ECC para IA em tempo fixo em vacas leiteiras mestiças em pequenas propriedades na Amazônia

### RESUMO

Este estudo investigou a eficiência de um dispositivo avaliador de ECC (escore de condição corporal) (DAEC) para identificar vacas com ECC adequado e, presumivelmente, com fertilidade mais alta quando submetidas a protocolos de inseminação artificial em tempo-fixado (IATF). Conduzimos o estudo em pequenas propriedades leiteiras no estado de Rondônia, Brasil. Vacas leiteiras mestiças (n = 141) foram submetidas a um protocolo de IATF e classificadas de acordo com a escala do DAEC em vacas com ECC baixo (vermelho; n = 55) ou ECC adequado (verde; n = 86). A prenhez por inseminação artificial (P/IA) foi analisada por regressão logística. Vacas classificadas como verde no DAEC apresentaram P/IA significativamente mais alto (41 de 86; 47,7%) que vacas classificadas como vermelho (15 de 55; 27,3%; P = 0,01). Conclui-se que o dispositivo avaliador de ECC é uma ferramenta eficiente para detectar vacas com adequado ECC e com consequente maior fertilidade na IATF.

**PALAVRAS-CHAVE:** fertilidade, leite, ovulação, prenhez, Vetscore

Dairy cows commonly lose body condition (BC) in the postpartum period due to physiological changes at the beginning of lactation that impact their metabolism. Several studies on dairy cows have quantified the effect of an inadequate BC score (BCS) on health (Markusfeld *et al.* 1997; Berry *et al.* 2007), fertility (Gillund *et al.* 2001; Roche *et al.* 2007a; Carvalho *et al.* 2014; Gobikrushanth *et al.* 2019), and milk yield (Waltner *et al.* 1993; Ruegg and Milton 1995; Domecq *et al.* 1997). Cows with a stable or increasing BCS during the first weeks of lactation have lower

serum concentrations of  $\beta$ -hydroxy-butyrate ( $\beta$ Hb) and non-esterified fatty acids (Carvalho *et al.* 2014; Barleta *et al.* 2017), lower incidence of clinical and subclinical metabolic diseases, and an acceptable calving interval, which enables these females to achieve high fertility cycles and, consequently, to exhibit calving intervals of up to 13 months consistently (Middleton *et al.* 2019).

Several studies demonstrated that cows with low BCS had fewer pregnancies per artificial insemination (P/AI) at first service (Domecq *et al.* 1997; Moreira *et al.* 2000;

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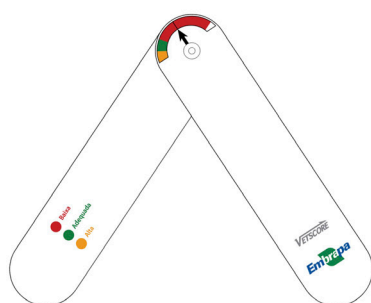
Santos *et al.* 2009). Furthermore, a substantial increase in P/AI was observed for cows that gained or maintained body condition during the first three weeks postpartum (Carvalho *et al.* 2014) and in situations where cows had moderate loss, maintained or gained BCS from calving to  $34 \pm 4$  days in milk (Gobikrushanth *et al.* 2019).

Although visual evaluation of BCS has been used as a tool for managing dairy herds since the 1970s (Lowman *et al.* 1976) and there is an extensive literature that endorses its importance (Edmonson *et al.* 1989; Waltner *et al.* 1993; Domecq *et al.* 1997), the inherent subjectivity of visual evaluations and the extra time spent to evaluate BCS individually somehow impairs the widespread use of BCS in farm routine. In that regard, a simple and accurate device has been developed to allow objective evaluations of BCS in beef cows. This device estimates the BCS by measuring the angle of the rump and classifies beef cows according to the device's BCS color scale as 'low' (red), 'adequate' (green) or 'high' (yellow) (Pfeifer *et al.* 2017). The latter authors have shown that postpartum beef cows with a 'green' BCS have greater P/AI than cows classified as 'red' or 'yellow'. Although the BCS assessment device (BCAD) has been used to select and classify beef cows that are more likely to get pregnant in TAI programs, the effectiveness of the use of this device to objectively evaluate BCS in dairy cows subjected to TAI programs has not been investigated yet.

Based on these considerations, the objective of this study was to evaluate the relationship of the BCAD color scale and fertility in crossbred dairy cows from Amazonian smallholders enrolled in TAI programs. The hypothesis tested here was that cows classified as 'green' by the BCAD have greater P/AI than cows classified as 'red'.

All experimental procedures described in here were approved by the committee for ethics in animal experimentation at Embrapa Rondônia (protocol # F02.2014 CEUA/Embrapa Rondônia).

Lactating Girolando crossbred (*Bos taurus* x *Bos indicus*) dairy cows with 1/2, 3/4, and 5/8 of blood share from three smallholders in the Vale do Anari ( $9^{\circ}51'16''S$ ,  $62^{\circ}10'32''W$ ), state of Rondonia, Brazil ( $n = 108$ ) were enrolled in this study. These smallholder dairy production systems are characterized by using mainly family labour with herds of approximately 25 lactating cows, producing, on average, 10 kg of milk/cow/day. To complement sample size, we also used 33 cows from Embrapa Rondônia's experimental research farm ( $8^{\circ}47'26''S$ ,  $63^{\circ}50'47''W$ ), totaling 141 cows. Cows were  $189 \pm 15$  days in milk, and a parity order from 3 to 10 at the beginning of the experiment. The BCAD used to evaluate the BCS of the cows enrolled in this study was the Vetscore® device (Figure 1; patent n. BRA1020140049916; Pfeifer *et al.*, Livestock Science 2017). The cows were classified according to their BCS as follows: low BCS (red,  $n = 55$ ) and adequate BCS (green,  $n = 86$ ). A subset of the cows ( $n = 100$ ) were also

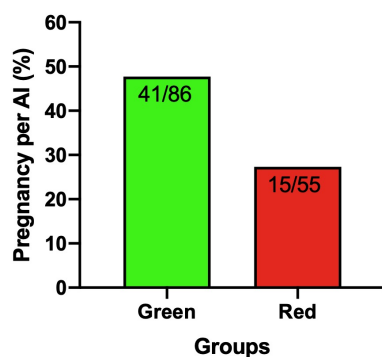


**Figure 1.** Schematic representation of the BCS assessment device to measure the BCS in dairy cows according to a color scale as follows: low BCS (red), adequate BCS (green), and high BCS (yellow). All cows in the present study have been classified according to the scale of the BCS assessment device in red and green only. The image on the right shows where the device is applied on the cow's body to obtain the BCS. Credit: Rafael Alves da Rocha. This figure is in color in the electronic version.

visually evaluated for BCS using a scale from 1 to 5 (1 = severe underconditioning, 5 = severe overconditioning) with 0.25 increment units (Edmonson *et al.* 1989). Cows were kept in pastures of *Brachiaria brizantha* grass and supplemented with corn and soybean concentrate (22% PB and 80% NDT), with *ad libitum* access to minerals and water. Milking occurred twice a day.

Immediately after use of BCAD and visual BCS evaluation, cows were subjected to an estradiol-progesterone TAI protocol, as follows. On day 0, 2 mg of estradiol benzoate i.m. (Bioestrogen®, Biogénesis-Bagó, Curitiba, Brazil) and intravaginal progesterone insert (1.9 g progesterone, CIDR®, Pfizer Animal Health, São Paulo, Brazil) to synchronize follicular wave emergence. The CIDR was removed on day 8, together with a treatment of 150 µg i.m. of d-Cloprostenol (PGF2α-analogue; Croniben®, Biogénesis-Bagó, Curitiba, Brazil) and 1 mg i.m. of estradiol cypionate (E.C.P.®, Pfizer, Cravinhos, Brazil). Timed artificial inseminations were performed 48 ± 2 h after CIDR removal by a single technician within each farm. All cows were inseminated using semen from eight commercial bulls with proven fertility. Ultrasound examinations were performed from 30 to 40 d after TAI for pregnancy diagnosis. Visualization of the embryonic vesicle and detection of the embryonic heartbeat were the positive criteria for pregnancy.

The cows evaluated by visual BCS were classified as having adequate BCS (n = 46) (BCS ≥ 3) or low BCS (n = 54) (BCS < 3). Binary variables were analyzed by logistic regression using the GLIMMIX procedure. We analyzed the main effect of BCS according to BCAD on pregnancy outcomes and the proportion of cows with adequate BCS using sire, parity, farm, and days of postpartum in the statistical model. As the covariates had no significant effect, they were excluded from the final model. All analyses were performed using the SAS program (SAS Institute, Cary, NC).

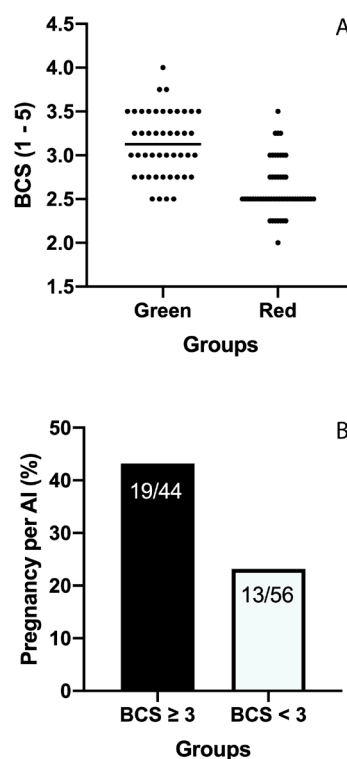


**Figure 2.** Pregnancy by timed artificial insemination (TAI) in crossbred dairy cows (n = 141) classified according to their BCS status as eligible (green) or non-eligible (red) for TAI using the BCAD. The proportion of pregnant cows (P/AI) differed significantly between the groups (P < 0.01). This figure is in color in the electronic version.

Cows classified as ‘green’ in the BCAD scale had a significantly greater P/AI than cows classified as ‘red’ (47.7% vs 27.3%, respectively; P = 0.01) (Figure 2). The visual assessment of BCS of the cows in each of the BCAD groups resulted in 71.7% of cows with BCS ≥ 3 in the green group and 79.6% of cows with BCS < 3 in the red group (Figure 3a). Cows with BCS ≥ 3 had greater P/AI than cows with BCS < 3 (43.2% vs 23.2%, respectively; P = 0.03) (Figura 3b).

The hypothesis tested in the present study has been confirmed. Crossbred dairy cows classified as ‘green’ by the BCAD had a significantly greater P/AI than cows classified as ‘red’. To the best of our knowledge, this is the first study that tested the usefulness of the BCAD to select dairy cows for TAI, predicting their likelihood of getting pregnant. The greater proportion of cows with adequate BCS in the ‘green’ group further supports the ability of the BCAD to distinguish accurately BCS in crossbred dairy cows.

Our results support the idea that BCAD is a useful tool for detecting cows with an increased probability to become pregnant in TAI programs. Cows considered with an adequate BCS by the BCAD (green) had an increase of 20% in P/AI compared with cows with low BCS by the BCAD (red). Other



**Figure 3.** A – Estimation of BCS by visual assessment (scale 1 to 5, with 0.25 increments) of crossbred dairy cows (n = 100) classified according to the BCAD as eligible (green) or non-eligible (red) on day 0 of the timed artificial insemination (TAI). B – Pregnancy by timed artificial insemination (TAI) in crossbred dairy cows (n = 100) with BCS ≥ 3 and BCS < 3. The proportion of pregnant cows (P/AI) differed significantly between the groups (P = 0.03).

studies have also demonstrated the relationship between visual BCS and TAI outcomes in dairy cows (Moreira *et al.* 2000; Carvalho *et al.* 2014). Cows with visual BCS  $\geq 3.5$  at TAI had greater P/AI than cows with BCS  $\leq 2.5$  (Carvalho *et al.* 2014). Accordingly, in the present study, cows with BCS  $\geq 3$  had greater P/AI than cows with BCS  $< 3$ .

An alternative to increase P/AI for low BCS dairy cows is the use of equine chorionic gonadotropin (eCG) on the day of removal of the progesterone insert. The effect of eCG was beneficial only in cows with low visual body condition scores ( $< 2.75$ ) (Souza *et al.* 2009). We did not use eCG in the cows enrolled in our study because this would affect the relationship between the BCAD classification and observed fertility.

The visual evaluation of BC is an easy and inexpensive method to estimate body tissue reserve in cows independently of the frame size and body weight (Edmonson *et al.* 1989). Its major disadvantage is the subjective nature of the method, as score attribution can vary considerably among technicians. As an alternative, the BCAD scores body reserves based on a simple and objective measuring device, eliminating subjectivity. In this sense, the BCAD may represent an important improvement in the determination of BCS in dairy cows, as it provides a reliable, objective and little time consuming evaluation, is inexpensive and easily available.

The BCS technique is a tool that has been widely used to quickly and cheaply estimate the energy reserves of dairy cows at regular intervals (Klopčič *et al.* 2011). While many may consider the BCS as a nutritional practice, the use of this tool to manage the BCS of cows in dairy farms has direct implications for milk yield, herd health, reproductive performance, animal welfare, and farm profitability (Bewley and Schutz 2008). The benefits of using BCS assessment as a tool to assist the nutritional and reproductive management of dairy cows have been widely described in the literature (Domecq *et al.* 1997; Moreira *et al.* 2000; Carvalho *et al.* 2014). However, despite these benefits, the systematic assessment of BCS is not a routine in most dairy farms, especially in those with extensive pasture-based systems. The BCAD provides an easily employable tool for BCS estimation that may aid dairy smallholders in establishing control routines to increase the fertility outcomes of TAI programs by selecting eligible cows in a more objective way. This may stimulate smallholders to use TAI, which is of particular interest in Brazil, where only about 12% of dairy cows are subjected to AI (ASBIA 2022).

In conclusion, cows classified as eligible for TAI (green according to the BCAD) had significantly greater pregnancy outcomes resulting from AI. Our results demonstrate that the BCAD can be an important tool for selecting dairy cows with a greater probability of getting pregnant.

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#### **DATA AVAILABILITY**

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

