ABSTRACT: The California net energy system (CNES) was the reference for the development of most energy requirement systems worldwide, such as Nutrient Requirements of Beef Cattle (NASEM, Nutrient requirements of beef cattle, 8th Revised ed, 2016) and Brazilian Nutrient Requirements of Zebu and Crossbred Cattle (Valadares Filho, S. C., L. F. C. Silva, M. P. Gionbelli, P. P. Rotta, M. I. Marcondes, M. L. Chizzotti, and L. F. Prados, BR-CORTE: nutrient requirements of zebu and crossbred cattle, 3rd ed, 2016). This review aimed to compare methods used by NASEM and BR-CORTE to estimate the energy requirements for beef cattle. The net energy requirements for maintenance (NE\textsubscript{m}) of BR-CORTE is based on empty body weight (EBW), whereas NASEM uses shrunk body weight (SBW), but the \textit{Bos taurus indicus} presents 10\% to 8\% lower NE\textsubscript{m} than \textit{Bos taurus}. We have compared animals with different EBW and SBW but with same equivalent empty body weight/standard reference weight ratio (0.75), as both systems have suggested different mature weights. Both systems predicted similar net energy requirements for gain (NE\textsubscript{g}) for animals with 1.8 kg of daily gain. However, estimated empty body gain was lower for NASEM estimations when the same metabolizable energy for gain is available. For pregnancy and lactation of beef cows, the NE\textsubscript{m} and net energy requirements for pregnancy (NE\textsubscript{p}) of a Zebu cow estimated by BR-CORTE were lower than the values estimated by NASEM. Furthermore, the magnitude of differences between these systems regarding NE\textsubscript{p} increased as pregnancy days increase. The NASEM and BR-CORTE systems have presented similar values for energy requirement for lactation (0.72 and 0.75 Mcal/kg milk, respectively).

Key words: beef cattle, BR-CORTE, Nellore, requirements

INTRODUCTION

The United States and Brazil are ranked first and second largest beef producers in the world, respectively (USDA, 2017). However, despite have accounting together for about 35\% of world’s beef production, both countries have distinct beef cattle production systems. In the United States predominates a specialized system using most \textit{Bos taurus taurus} steers finished in feedlots on high-energy diets aiming to increase beef marbling. On the other hand, Brazilian beef cattle systems are based on tropical grasses pastures with only 9\% of beef cattle finished in feedlots in 2017 (ANUALPEC, 2018). Furthermore, \textit{Bos taurus indicus} bulls are predominant in Brazilian system, resulting in lower
percentage of marbling of beef and leaner carcasses, and usually no price difference or marbling grades are used by this country’s industry, making the use of Zebu bulls more profitable.

The accurate estimation of energy requirements for growing and finishing cattle is a major key point for diets formulation. The California net energy system (CNES) was first developed by Lofgreen and Garrett (1968), which uses data from several studies (Atwater and Bryant, 1900; Armsby, 1917; Kleiber, 1961; Blaxter, 1962, 1969; Brody, 1945; Blaxter et al., 1966) that have evaluated the most varied aspects of energy usage by cattle (mainly *Bos taurus taurus*) as basis for its proposed definitions. The CNES in turn established the basis for energy requirement recommendations of the subsequent editions of the North American System (NRC, 1984, 1996, 2000; NASEM, 2016). However, due to differences between carcasses (especially marbling) produced in the United States and Brazil, the CNES may not correctly estimates the energy requirements for Zebu bulls under tropical condition. Thus, a Brazilian system was developed and has been regularly updated. We present the Brazilian system entitled Nutrient Requirements of Zebu and Crossbred Cattle, BR-CORTE, (Valadares Filho et al., 2016) and contrast with CNES (Lofgreen and Garrett, 1968) and NASEM (2016) for requirement recommendations of the subsequent editions of the North American System (NRC, 1984, 1996, 2000; NASEM, 2016). The BR-CORTE system uses a database from studies using mostly direct body composition (Garrett et al., 2010, 2012). The inclusion of new variables into models to predict body and carcass composition, such as effects of gender and genotype, as well other body components such as visceral fat, have improved the estimates from the 9th to 11th rib section for Zebu cattle and are currently adopted as the indirect method used in BR-CORTE database.

**NUTRIENT REQUIREMENTS OF ZEBU AND CROSSBRED CATTLE—BR-CORTE**

Brazilian studies on evaluation of cattle nutritional requirements have started in the 1980s, and the first attempt to systematize these requirements data was made in 1995, at the International Symposium on Nutritional Requirements of Ruminants, in Viçosa, Brazil. The first edition of BR-CORTE system (Valadares Filho et al., 2006) was published in June 2006 and has used individual data from about 180 Zebu bulls (from nine studies) on feedlot. Since then, the number of studies and data has increased and the second version of BR-CORTE, published in 2010, included information of crossbred animals as well as the new chapters on cows and calves requirements. The last edition of BR-CORTE was published in October 2016 and had included four new chapters, using a new and updated database collected from different Brazilian universities (Valadares Filho et al., 2016), integrating the National Institute of Animal Science (INCT-CA). The updated BR-CORTE gathered individual data from 1,369 animals used in 38 studies, regarding nutritional requirements for Zebu, dairy and beef crossbred cattle, fed on pasture or feedlot under Brazilian beef cattle production conditions.

The BR-CORTE’s methodology on the estimation of energy requirements for growing and finishing cattle was based on the CNES presented by Lofgreen and Garrett (1968). To use this system, the first step is determining animals' body composition, and from comparative slaughter of an initial group, estimating the initial body energy content, to further estimate the net energy retained in the body.

Methods used to predict body composition can be classified as direct or indirect. Direct methods are expensive, very labor-intensive, and slow, as separation and dissection of all body components are necessary for the further quantification of physical and chemical components. On the other hand, body composition might be predicted by indirect methods without the necessity of complete carcass dissection. The BR-CORTE system uses a database from studies using mostly direct body composition (Garrett et al., 1959) and some indirect methods based on rib sections composition (Marcondes et al., 2010, 2012).

**USE OF THE 9TH-10TH-11TH RIB CUT FOR PREDICTION OF BODY COMPOSITION**

Hankins and Howe (1946) have developed equations for prediction of carcass physical and chemical composition from a rib section between the 9th and 11th ribs. These equations were developed from data obtained from steers and heifers, and three equations (one for each gender and one wide-ranging) were proposed. The accuracy of original equations from Hankins and Howe (1946) was not satisfactory for Zebu or crossbred bulls, and reparametrized equations were developed by Marcondes et al. (2010, 2012). The inclusion of new variables into models to predict body and carcass composition, such as effects of gender and genotype, as well other body components such as visceral fat, have improved the estimates from the 9th to 11th rib section for Zebu cattle and are currently adopted as the indirect method used in BR-CORTE database.

**ENERGY REQUIREMENTS**

For maintenance requirements, the nonlinear relationship of heat production (HP) and metabolizable energy intake (MEI) is used to estimate the fasting HP, expressed as energy per unit of metabolic body weight.

The BR-CORTE’s dataset used to obtain energy requirements is composed of 1,369 animals.
from 38 studies carried out under Brazilian conditions. These animals were distributed in three genetic groups (54% Nellore, 25% crossbred beef, and 25% crossbred dairy), two feeding system groups (91% feedlot and 9% pasture), and three gender groups (62% bulls, 26% steers, and 12% heifers). The net energy requirements for maintenance (NE\text{m}) were estimated using an exponential nonlinear regression of HP as a function of MEI \((\text{Ferrell and Jenkins, 1998})\), according to the general model:
\[\text{HP} = \beta_1 \times e^{(\beta_2 \times \text{MEI})}.\]

Fixed effects of gender, genetic group, and feeding system were tested in mixed models considering the random effects of studies. The intercept \(\beta_1\), representing NE\text{m}, was not affected \((P > 0.05)\) by gender, genetic group, or feeding system, which indicates no differences in NE\text{m} \((0.0749 \text{ Mcal/EBW}^{0.75}/\text{d})\). Therefore, BR-CORTE proposed a general value of 75 kcal/EBW\text{0.75}/d for NE\text{m}. Nonetheless, the exponent \(\beta_2\) was greater for crossbred dairy group followed by crossbred beef and Nellore, respectively \((P < 0.01)\). These results indicate that genetic group influences the efficiency of use of metabolizable energy for maintenance \((K_{\text{m}})\). Therefore, three equations were proposed to estimate metabolizable energy requirements for maintenance (in Mcal/EBW\text{0.75}/d) for Zebu \((\text{HP} = 0.0749 \times e^{3.8684 \times \text{MEI}})\), beef crossbred \((\text{HP} = 0.0749 \times e^{4.0612 \times \text{MEI}})\), and dairy crossbred \((\text{HP} = 0.0749 \times e^{4.1487 \times \text{MEI}}; \text{Figure 1})\).

Conceptually, metabolizable energy requirements for maintenance (ME\text{m}) can be defined as MEI to achieve null energy balance in body \((\text{RE} = 0)\), or \(\text{MEI} = \text{HP}\) \((\text{Lofgreen and Garrett, 1968})\). The ME\text{m} can be estimated by iterative process from the aforementioned equations, and our data indicate an ME\text{m} of 118, 124, and 125 kcal/EBW\text{0.75}/d for Zebu, beef crossbred, and dairy crossbred, respectively, indicating a difference of about 5.2% on ME\text{m} for Zebu in comparison with their crosses.

The NE\text{m} estimated by CNES and adopted by NASEM (2016) was of 77 kcal/SBW\text{0.75}/d for a Bos taurus taurus steer. The CNES and NASEM (2016) use shrunk body weight (SBW) whereas BR-CORTE uses empty body weight (EBW) to estimate the NE\text{m}, which can generate confusion during direct comparison of both systems or genotypes. Therefore, in CNES and NASEM (2016), the NE\text{m} of a 450 kg of body weight steer of Bos taurus genotype will be calculated from the SBW of 432 kg \((\text{SBW} = \text{BW} \times 0.96)\), resulting in an NE\text{m} of 7.30 Mcal/d \((0.077 \times 432^{0.75})\). In contrast, a Bos taurus indicus steer of 450 kg in BR-CORTE system will be estimated from 441 kg of SBW and 398 kg of EBW, resulting in an NE\text{m} of 6.69 Mcal/d \((0.075 \times 398^{0.75})\), which is about 8% smaller than that obtained from CNES (Figure 2). Therefore, there might be a difference between Bos taurus indicus and Bos taurus taurus for NE\text{m}.

Different from NASEM (2016), the BR-CORTE system does not adjust NE\text{m} for gender condition, as there was no difference between them on our dataset. The NASEM recommended a 15% increase in NE\text{m} for bulls. Furthermore, the NASEM also proposed a reduction of 10% in NE\text{m} requirements of Zebu cattle, except for Nellore. The BR-CORTE does not propose any corrections for gender or genetic group for NE\text{m}.

The estimation of EBW is also different between systems. In NASEM (2016) the EBW is considered as a fixed fraction 0.891 of SBW. Nonetheless, our data indicate a nonlinear relationship between EBW and SBW, evidenced by the increased carcass yield observed for heavier animals. Therefore, the BR-CORTE has dedicated an

![Figure 1](https://example.com/fig1.png)

**Figure 1.** Representation of the relationship between heat production (HP) and metabolizable energy intake (MEI) by using BR-CORTE equations.
entire chapter just to estimate EBW, as its prediction was affected by gender and genotype and also by SBW (Table 1).

Gomes et al. (2016) evaluated the nutrient requirements of Angus purebred and Nellore purebred bulls under tropical conditions and reported that Angus bulls had 28% greater NE\textsubscript{Em}, 29% greater intake, and 146% greater respiration rate than Nellore bulls, indicating that under heat stress of tropics, the difference between purebred \textit{Bos taurus taurus} and \textit{Bos taurus indicus} might be even higher than that suggested by NASEM (2016).

### Energy Requirements for Gain

The understanding of the composition of gain is critical to estimate energy requirements and is related to the stage of maturity of the animal (Marcondes et al., 2015). The NRC (2000) suggests the use of equivalent empty body weight (EQEBW) to correct energy requirements for gain of animals with different frame size (or BW at maturity), in order to generate an equivalent value among all animals. The EQEBW allows the comparison of animals with different genetic groups and/or gender at different finishing grades. The EQEBW can be calculated from mature EBW and a standard reference weight (SRW), adopting the following model: EQEBW = (EBW/mature − EBW) × SRW. The NASEM (2016) uses four different SRW, according to empty body fat (EBF) content: 478 kg for animals with small marbling (28% EBF), 462 kg for animals with slight marbling (27% EBF), 435 for animals with traces of marbling (25% EBF), and 400 for animals devoid of marbling (22% EBF). For the BR-CORTE, the mature EBW was suggested for each gender and genotype, from the relationship of body fat and EBW. It was considered a body composition of 25% EBF as the weight at maturity for Zebu cattle, because of a low degree of beef marbling. Thus, the BR-CORTE suggests the following mature EBWs: for Zebu = 517, 433, and 402 kg for bulls, steers, and heifers, respectively; for beef crosses = 560, 482, and 417 kg for bulls, steers, and heifers, respectively; for dairy crosses = 616, 532, and 493 kg for bulls, steers, and heifers, respectively. The SRW of BR-CORTE is of 517 kg, and the estimate of EQEBW based on different mature BWs, account for most of the variation of gender and genotype on net energy requirement for gain (NE\textsubscript{g}).

The BR-CORTE estimates NE\textsubscript{g} based on net energy retained in the body as a function of EQEBW and empty body gain (EBG) with a similar equation ($NEg = 0.061 \times EQEBW^{0.75} \times EBG^{1.035}$) to the one adopted by NASEM (0.0635 × EQEBW\textsuperscript{0.75} × EBG\textsuperscript{1.097}). It is important to depict that there is a small difference in the coefficients of equation to predict NE\textsubscript{g} between systems (0.061 vs. 0.0635, and 1.035 vs. 1.097), which will result in reduced energy content in the gain for Zebu cattle (BR-CORTE) than that of \textit{Bos taurus} cattle (NASEM), consistent with the lower marbling of beef.

For metabolizable energy requirements for gain (ME\textsubscript{g}), an efficiency of the use of metabolizable energy for gain (Kg) needs to be calculated. The efficiency of body energy retention depends on the proportions of energy retained as protein and as fat, because energy deposition as fat is more efficient than that as protein (Owens et al., 1995). The BR-CORTE (2016) adopts a nonlinear equation to predict Kg from the energy content in the gain: $Kg = 0.327/(0.539 + [1.14 \times (NEg/EBG)]^{-1.137})$. On the other hand, the NASEM (2016) uses the diet ME concentration to estimates Kg, leading to some difference on energy required for gain.

![Net energy requirements for maintenance](image_url)
Table 1. Equations of BR-CORTE (2016) and NASEM (2016) systems used to estimate energy requirements in Table 2

| Item                  | BR-CORTE (2016)                                                                 | NASEM (2016)                                                                 |
|-----------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| DMI, kg               | Zebu = −1.7824 + 0.07765 × BW^{0.75} + 4.0415 × ADG − 0.8973 × ADG^2;           | If Km ≥ 1, (1.2425 + 1.9218 × Km − 0.7259 × Km^2) × SBW/100;                 |
|                       | Crossbred beef = −0.6273 + 0.06453 × BW^{0.75} + 3.871 × ADG − 0.614 × ADG^2;   | If Km < 1, (1.2425 + 1.9218 × 0.95 − 0.7259 × 0.95 × 0.95) × SBW/100          |
| Diet ME, Mcal/kg      | ME of diet D used in chapter 20’s tables of NASEM                                | ME of diet D used in chapter 20’s tables of NASEM                            |
| SRW, kg               | SRW considering an animal with 25% of body fat                                    | SRW considering an animal with 28% of empty body fat                         |
| SBW, kg               | Zebu = 0.88 × BW^{0.0175}; Crossbred beef = 0.9664 × BW^{0.0017}                 | 0.96 × BW                                                                   |
| Mature SBW, kg        | —                                                                               | Reference values used in chapter 20’s tables                                  |
| Mature EBW, kg        | Zebu: bull = 517; steer = 433; heifer = 402; Crossbred beef = 560; steer = 482; heifer = 417 | Mature SBW × 0.891                                                           |
| EQSBW, kg             | —                                                                               | SBW × (SRW/mature SBW)                                                       |
| EBW, kg               | Zebu: bull = 0.8125 × SBW^{0.034}; steer = 0.6241 × SBW^{0.066}; heifer = 0.611 × SBW^{0.066}; | 0.891 × SBW                                                                 |
|                       | Crossbred beef: bull = 0.7248 × SBW^{0.034}; steer = 0.6586 × SBW^{0.066}; heifer = 0.6314 × SBW^{0.002} |                                                                    |
| EQEBW, kg             | EBW/mature EBW × SRW                                                           | 0.891 × EQSBW                                                                |
| EQEBW/SRW             | 75%                                                                             | 75%                                                                          |
| EBG, kg               | 0.963 × ADG^1.015                                                               | 0.956 × ADG                                                                  |
| NEm, Mcal/d           | 0.075 × EBW^{0.75}                                                             | Bos taurus taurus: heifer and steers = 0.077 × SBW^{0.75}; passengers = 0.15 × lower |
| NE, Mcal/d            | 0.061 × EQEBW^{0.75} × EBG^{1.055}                                             | 0.0635 × EQEBW^{0.75} × EBG^{1.007}                                          |
| Km                   | Zebu = 0.513 + 0.173 × Kg + 0.1 × EBG; Crossbred beef = 0.513 + 0.173 × Kg + 0.073 × EBG | (1.37 × Diet ME − 0.138 × Diet ME^2 + 0.0105 × Diet ME^3 − 1.12)/Diet ME      |
| Kg                   | 0.327/(0.539 + (1.14 × (NEG/EBG)^1.173))                                       | (1.42 × Diet ME − 0.174 × Diet ME^2 + 0.0122 × Diet ME^3 − 1.65)/Diet ME      |
| MEm, Mcal/d           | NEm/Km                                                                          | NEm/Km                                                                       |
| MEg, Mcal/d           | NEg/Kg                                                                          | NEg/Kg                                                                       |
| MEt, Mcal/d           | MEm + MEg                                                                       | MEm + MEg                                                                    |
| DE, Mcal/d            | ((ME/DMI) + 0.3032) × 0.9455) × DMI                                            | ME/0.82                                                                      |
| TDN, kg               | DE/4.4                                                                          | DE/4.4                                                                       |

ADG = average daily gain; DMI = dry matter intake; ME = metabolizable energy; EQSBW = equivalent shrunk body weight; NE = net energy requirement; Km = efficiency of use of NEm; Kg = efficiency of use of NEg; MEt = total metabolizable energy requirement; DE = digestible energy requirement; TDN = total digestible nutrients requirement.

BR-CORTE (2016) VS. NASEM (2016)

Growing and Finishing Cattle

Table 1 shows the equations used to estimate energy requirements presented in Table 2, which compares BR-CORTE (2016) and NASEM (2016) systems. Because both systems have suggested different mature weights, we decided to compare animals with different EBW and SBW but with same EQEBW/SRW ratio (0.75). Therefore, both systems presented similar NEg for animals with 1.8 kg of average daily gain, as proposed equations are similar too.

The BR-CORTE system uses 517 kg as SRW. On the other hand, the NASEM suggests an SRW of 478 kg, considering an animal with 28% of EBF. The mature SBW used for NASEM calculations were those described in chapter 20.

Differences in Km and Kg calculations between both systems also should be highlighted. The NASEM equations use only diets ME, whereas BR-CORTE equations consider EBG, NEg, and Kg variables. Generally, BR-CORTE Km and Kg present greater values than those calculated using NASEM.

The EBG can also be estimated from the net energy available for gain. Thus, we have compared EBG estimates from BR-CORTE and NASEM for animals with 440 kg of SBW and using 6 Mcal/d NEg. For BR-CORTE, calculated EBG was 1.12 kg/d (EBG = 14.914 × (0.9662 × 388 −0.7246), whereas NASEM’s estimated EBG was 1.07 kg/d \{(EBG = 12.341 × [6/(0.891 × 440)^{0.75}]^{0.9116})\}. Therefore, BR-CORTE system estimates an EBG 5.2% greater for Zebu cattle compared to NASEM.
Table 3. Summary of the equations used to estimate energy requirements for lactating beef cows in Table 4

| Item                          | BR-CORTE (2016)                  | NASEM (2016)                  |
|-------------------------------|----------------------------------|-------------------------------|
| SBW, kg                       | 0.88 × BW$^{1/227}$              | 0.96 × BW                     |
| EBW, kg                       | 0.8507 × SBW$^{0.002}$           | 0.891 × SBW                   |
| NE,$_{m}$, Mcal/d             | 0.0978 × EBW$^{0.75}$           | 0.077 × SBW$^{0.75}$ × L      |
| ME,$_{m}$, Mcal/d             | 0.135 × EBW$^{0.75}$            | NE$m$/Km                      |
| Km                           | NE$m$/ME$m$                      | NE$m$/ME$m$                   |
| NE,$_{p}$, Mcal/d             | [CBW × (0.000000793 × DP$^{0.01}$)]/1,000 | [CBW × (0.05855 – 0.0000996 × PD) × e$^{-0.0323$ × PD – 0.0000275 × PD$^{2}$}]1,000 |
| Kp                           | 0.12                             | NE$p$/Kp                      |
| EM$p$, Mcal/d                | NE$p$/Kp                        | NE$p$/Kp                      |
| NE,$_{m}$, Mcal/kg milk       | 0.75                             | 0.72                          |
| NE,$_{m}$, Mcal/d             | NE$m$ × milk yield               | NE$m$ × milk yield            |
| K$_{m}$                       | K$_{m}$ = Km                     | K$_{m}$ = Km                  |
| ME,$_{m}$, Mcal/kg milk       | NE$m$/K$_{m}$                    | NE$m$/K$_{m}$                  |
| ME,$_{f}$, Mcal/d             | EL/K$_{f}$                      | EL/K$_{f}$                    |
| NE,$_{f}$, Mcal/d             | NE$f$ + NE$p$ + NE$_{t}$        | NE$f$ + NE$p$ + NE$_{t}$      |
| ME,$_{f}$, Mcal/d             | ME$f$ + ME$p$ + ME$_{t}$        | ME$f$ + ME$p$ + ME$_{t}$      |

L = lactating factor (1.2 for Nellore cows); Km = efficiency of use of ME$m$ to NE$m$; NE$m$a = net energy for maintenance available in the diet, calculated as NE$m$a = 1.37 × ME – 0.138 × ME$^2$ + 0.0105 × ME$^3$, where ME is dietary metabolizable energy; NE$p$ = net energy requirement for pregnancy; CBW = calf birth weight (kg); DP = days pregnant; Kp = efficiency of use of ME$p$ to NE$p$; ME$p$ = metabolizable energy requirement for pregnancy; NE$_{f}$ = net energy requirement for lactation; K$_{f}$ = efficiency of use of ME$_{f}$ to NE$_{f}$; ME$_{f}$ = metabolizable energy requirement for lactation; NE$_{t}$ = total net energy requirement; ME$_{t}$ = total metabolizable energy requirement.
Table 4. Energy requirements for beef cows in different stages of pregnancy and milk yield calculated based on BR-CORTE (2016) and NASEM (2016) systems

| Item                       | System                      |
|---------------------------|-----------------------------|
|                           | BR-CORTE (2016) | NASEM (2016) |
| BW, kg                    | 500                        | 500           |
| SBW, kg                   | 491                        | 480           |
| EBW, kg                   | 418                        | 428           |
| CBW, kg                   | 32                         | 32            |
| Requirements              |                             |               |
| 180 d pregnant            | 0.16                       | 0.18          |
| 210 d pregnant            | 0.26                       | 0.32          |
| NEp, Mcal/d               | 0.16                       | 0.18          |
| MEp, Mcal/d               | 1.35                       | 1.37          |
| 5 kg milk                 | 3.75                       | 3.60          |
| 8 kg milk                 | 6.00                       | 5.76          |
| NEl, Mcal/d               | 5.21                       | 6.25          |
| MEl, Mcal/d               | 8.33                       | 10.0          |
| Efficiency of use of ME to NE |                  |
| Km                        | 0.72                       | 0.58          |
| Kp                        | 0.12                       | 0.13          |
| Kt                        | 0.72                       | 0.58          |

CBW = calf birth weight; MEp = metabolizable energy requirement for pregnancy; NEp = net energy requirement for lactation; MEp = metabolizable energy requirement for lactation; Km = efficiency of use of MEM to NEm; KP = efficiency of use of MEp to NEp; Kt = efficiency of use of MEp to NE; ME = metabolizable energy for lactation.

Figure 3. Net energy requirements for pregnancy of a Nellore cow carrying a calf with estimated 32 kg calving weight calculated based on BR-CORTE (2016) and NASEM (2016) systems.

Pregnancy and Lactation Beef Cows

A summary of the equations proposed by BR-CORTE (2016) and NASEM (2016) systems for estimating energy requirements of pregnancy and lactation beef cows is presented in Table 3. An example of the net and metabolizable energy requirements estimated by both systems is presented in Table 4. In this example, a Nellore cow with 500 kg BW, gestating a calf with estimated 32 kg of calving weight, with different days of pregnancy (180 and 210 d) and milk yields (5 and 8 kg), was considered.

The NEm estimated by the NASEM (9.48 Mcal/d) system was approximately 5% greater than the value estimated by BR-CORTE (9.04 Mcal/d), whereas the MEM estimated by NASEM (16.5 Mcal/d) was approximately 32% greater than BR-CORTE estimation (12.5 Mcal/d). The lower Km considered by NASEM (0.58) compared to BR-CORTE (0.72) may help to explain the greater MEM values obtained when NASEM system is used.

With regard to requirements for pregnancy, greater net energy requirements for pregnancy (NEp) were estimated by NASEM system when compared to BR-CORTE. The NASEM NEp estimates for 180 and 210 d pregnant cows were approximately 12.5% and 23% greater than BR-CORTE system estimates, respectively. In addition, it should be noted that the magnitude of differences between these systems regarding NEp increased as pregnancy days increased (Figure 3). As the efficiencies of use of energy for pregnancy (Kp) were similar between both systems (Kp = 0.12 and 0.13 for BR-CORTE and NASEM, respectively), the
magnitude of differences between them was maintained when the metabolizable energy requirements for pregnancy were estimated.

Considering an average milk composition, similar net energy requirements for lactation were obtained from NASEM or BR-CORTE systems (0.72 and 0.75 Mcal/kg milk, respectively). However, these systems considered different efficiencies of use of metabolizable energy for lactation (0.58 and 0.72 for NASEM and BR-CORTE systems, respectively). Therefore, the metabolizable energy requirement for lactation estimated by NASEM was approximately 19% greater than that estimated by BR-CORTE (1.24 and 1.04 Mcal/kg milk, respectively).

**CONCLUSIONS**

The BR-CORTE uses EBW to predict net energy for maintenance, which is predicted from different nonlinear equations for genotype, gender, and production systems, and does not consider differences of gender or genotype on net energy for maintenance. A Nellore steer of 450 kg in BR-CORTE has about 8% lesser NE\textsubscript{m} than an Angus steer of the same weight in CNES and NASEM systems.

The NE\textsubscript{g} is slightly smaller in BR-CORTE than in NASEM, because of differences in beef marbling and mature weight considered. The prediction of EBG is greater for BR-CORTE than that for NASEM, when the same metabolizable energy for gain is available.

The net energy for maintenance of a Zebu cow estimated by BR-CORTE was slightly lower than that estimated by NASEM system, whereas greater efficiency of use of energy for maintenance was considered by BR-CORTE compared with NASEM. Lower estimates of net K\textsubscript{p} were observed using BR-CORTE system compared to NASEM. The NASEM and BR-CORTE systems presented similar values for net energy for lactation. However, as BR-CORTE presented greater efficiency of use of energy for lactation than NASEM, the metabolizable energy for lactation (Mcal/kg milk) estimated by NASEM was greater than that estimated by BR-CORTE system.

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