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Body Condition Score, Rectal Temperature, Respiratory, Pulse and Heart Rates of Tropical Indigenous Zebu Cattle : A Review

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Abstract – **The objective of the study is to review the reference values of body condition score, rectal temperature, respiratory, pulse and heart rates of tropical indigenous zebu cattle. The purpose of condition scoring, therefore, is to achieve a balance between economic feeding, good production and good welfare. Cattle rectal temperatures have, also, been used in detection and management of diseases and changes in the state of cows' estrus, heat stress and the onset of calving for decades. It is important for a farmer to know the normal values of these physiological parameters to enable him take proper management decisions. These physiological parameters are good indicators of nutritional and health status of animals. Calving ease increased with age, parity, health and body condition score of a dam. Poor body condition score also affect rectal temperature, respiratory, pulse and heart rates. It is also associated with reduced income per cow, increased post-partum interval, weak calves at birth, low quality and quantity of colostrum, reduced milk production, increased dystocia, and lower weaning weights. Farmers should watch closely for any deviation of these physiological parameters from the normal values and should able to take appropriate action when abnormalities are observed.**

Keywords – **Body Condition Scores, Physiological parameters, Pastoral, Cattle, Tropics.**

I. Introduction

Body weights and condition scoring are the traditional methods used to assess nutritional status of animals [1 and 2]. This is because nutritional status of cattle is useful in quantifying the extent to which cattle are affected by diseases or other environmental factors, especially where seasonal fluctuations in the quantity and quality of forages occur, as is common during different seasons in tropical and sub-tropical areas [3]. An animal's body temperature is the result of the balance between heat produced by the basal metabolism and muscular activity of the body and the heat lost from the body [4]. Rectal temperatures, Respiration, pulse and heart rates have been used as reliable indicators of short time physical stress in animals [5, 6, 7 and 8]. The objective of the study is to review the reference values of body condition score, rectal temperature, respiratory, pulse and heart rates of tropical indigenous zebu cattle.

II. Cattle Performance Evaluation

Body Condition Scores

Body condition scoring describes the systematic process of assessing the degree of fatness of an animal [9, 10 and 2]. The score reflects the plane of nutrition on which an animal has been exposed over a reasonable length of time [11]. The loin, ribs, tail head, brisket, flank, vulva and/or rectum and udder are the important parts of the body used in determining the score. Physiologically, the proportion of protein and water of the animal's bodyweight decrease as it gains body condition [12].

Several authors have documented association between body condition scoring and fertility [13] and health [14]. The 6 -point scale otherwise known as the Scottish or British system of scoring is, however, quite popularly used by many livestock producers. Body condition scoring is easy to apply and has been extensively used as a management tool largely in the dairy and beef sectors. It is, however, least reliable for calves and weaners, as they tend not to have heavy fat deposits.

Despite the reported repeatability estimates in experienced assessors, the general subjective nature of body condition scoring makes it difficult for inexperienced herd managers to correctly score the animals [15]. Unlike body weight measurements, the automation of body condition scoring has, to date, been unsuccessful [16]. There is a general consensus that, the genes that influence body condition scores and body weights are either closely linked or could have pleiotropic effects on each other. [16] observed a low correlation coefficient between body weight and condition scores. The objective indicator of nutritional status, which could be reliably and routinely used to aid management of cattle in rural areas, is to determine levels of nutritionally related blood metabolites [17 and 18].

Earlier workers such as [19 and 20] reported 6-point scale, with point 0 being animals that are severely emaciated and at the point of death while point 1 has the animals that are emaciated and physically weak with all ribs and bone structure easily visible. Cattle in this score are extremely rare and are usually inflicted with a disease and/or parasitism [9, 10 and 2]. In score 2, the animals appear emaciated, similar to BCS 1, but not weakened. Muscle tissues seem severely depleted through the hindquarters and shoulders. Score 3 has animals that appear moderate to thin. The last two ribs can be seen and little evidence of fats is present over the ribs, or around the tail heads. The spine processes are smooth and not individually identifiable. Score 4 has animals appearing in very good flesh. The tail heads show pockets of fats and the backs appear square due to fats. The ribs are very

smooth and soft to handling due to fats cover. Score 5 cows are obese. Their necks are thick and short and their backs appear very square due to excessive fats with heavy fats pockets around the tail heads.

Body condition score (BCS) of cows at the time of calving has the greatest impact on subsequent rebreeding performance [1]. On the average, cows that calve in a BCS 3 or 4 have difficulty exhibiting their first heat by 80 days after calving. However, cows that calve in BCS 5 tend to exhibit heat by 55 days after calving and, therefore, have a better opportunity to maintain a 365-day calving interval [1].

Thin cows at calving (BCS 3 or thinner) produce less colostrum, give birth to less vigorous calves that are slower to stand and these calves have lower immunoglobulin levels, thus impairing their ability to overcome early calf-hood disease challenges. This illustrates the importance of targeting mature cows to calve in a BCS of 5. Because 1st-calf-heifers have only reached about 85% of their mature weight after calving and require additional nutrients to support growth, they need to be fed so they are a BCS of 5 at calving.

Body condition scoring can be done using only visual indicators or a combination of visual and palpation of key bone structures for fat cover [1]. Palpation can be done during routine processing of cows through a chute. The key areas for evaluation are the backbone, ribs, hips, pinbones and tailhead. Palpating cows for fatness along the backbone, ribs, and tailhead will help refine that skill of visual assessment of body condition. This is because, using eyes to judge body condition can be difficult with cattle, like Highland or Galloway cattle, with the thick hair that hide a lot of what you can feel by touch. Body condition scores should be recorded so that links to productivity and herd management can be examined. Several years of such information could reveal, for example, needed management changes. Other factors in addition to hair coat that can affect visual body condition scores are age of cow, rumen fill, and stage of pregnancy. However, the greatest single factor influencing re-breeding performance of beef cows is body condition at calving, especially for spring-calving females. If producers wait until calving to manage body condition of their cows, they will find it very difficult and expensive to increase the body condition of a lactating cow.

Although evaluation of body condition can be looked at as an ongoing process, there are several key times when body condition scoring should be considered. These periods include late dry season in systems where females are managed almost entirely on vegetative or dormant grazed forage. For example, if cows are thin, early weaning should be considered. Non-lactating cows may pick up condition by grazing forage alone or by feeding a small amount of supplement along with the grazed forage. Again, if young cows are thin and grass in the pasture is decreasing in nutrient quality, there is need to strategically wean calves. Particular attention should be paid to young cows weaning their first calves, as they are most likely to be thin at this time. There may be need to consider early weaning of calves and giving cows access to higher quality forage.

For years, progressive cattle producers have recognized the important relationship between the physical appearance of their animals and reproductive performance outcomes. Body condition scores, also, allow producers to group cattle according to their nutritional requirements, thereby improving the efficiency of nutrition programs. Furthermore, body condition scores standardizes the description of body condition in beef cows which greatly enhances communication among cattle producers, university educators, veterinarians and industry advisors. Body condition scoring of cows allows for analysis of present management practices and application of research results and recommendations for individual cattle herds [21].

Fertility is the ability of male and female animals to produce viable germ cells, mate, conceive and deliver normal living young ones. The lifetime productivity of a cow is influenced by age at puberty, age at first calving, calving interval and number of services per conception and calving to conception interval [22 and 23]. Reproductive ability is the primary source of all benefits derived from livestock, but earlier selective breeding has focused on increased animal production traits [24 and 25]. The reproductive performances of a herd have been shown to be one of the most important starting points in any animal improvement package [22]. This implies that, whatever the goal of the production system is, reproductive traits appear to be economically important in cattle improvement programmes.

There is a relationship between body condition scores (BCS) of grazing animals and feed availability [26]. Malnutrition, old age and sickness are major causes of low body condition scores in cattle which affect every area of production [27]. Older cattle have less fat over their backs and *Bos indicus* cattle carry more external and internal fat than *Bos Taurus*. Also, bulls have higher BCS compared to cows [28]. A cow's reproductive performance is closely associated with her body energy reserves, for example, a low feeding level at service can reduce reproductive efficiency [29].

Similarly, Cows with low body condition scores have reduced fertility rates, milk yield, late postpartum oestrus and low weaning weights [29].

Body condition scores improve with nutrient availability [26] and because of this, it usually serves as a more reliable indicator of nutritional status of animals than body weights [26]. The general purpose of condition scoring however, is to achieve a balance between economic and efficient feeding, good management, market weights and welfare [26]. [30] in Mubi, North-Eastern guinea savannah zone of Nigeria, investigated physiological consequences of season, breed, body condition score and age on epididymal sperm reserve of bulls and found that reserves were highest during late rainy season in Red Bororo bulls of 4years old at BCS 5 which corresponded with the peak period of feed availability in the area.

According to [31], genetic makeup plays vital role in reproduction efficiencies, weaning weights and body

condition scores in cattle. Higher body condition scores precede higher dressing out percentage with good quality meat which, also, attracts greater market values. However, production without access to market is a problem for many livestock producers in Nigeria [32]. Pastoral populations in Northern Nigeria lack reliable marketing outlets that could provide the full benefits of indigenous cattle resources, to be captured by both pastoralists and consumers in the region and beyond. Market prices of cattle in Nigeria are determined by visual evaluation which incorporates elements of BCS, ages, sexes, breeds, live weights and grade [33, 34, 35 and 36].

According to [37] traditional methods of reducing morphometric effects of lean feed resources period remain forage conservation either as hay or silage during times of abundance in order to off-set pasture deficit during the dry season. This may serve as a suitable strategy to alleviate the effects of inadequate pasture during the dry season, while supplementing inadequate pasture with tree fodder provides another cost-effective alternative [38]. However, there is a significant shortfall in supply of the forage particularly when required for longer periods. Concentrate supplementation has, also, been traditionally seen as a reliable strategy; however, cost and availability of local concentrate sources is a major deterrent [37]. Use of crop residues and agricultural by-products as intervention nutrients is, also, commonly practiced [39]. Movement of animals and splitting of herds have been used by pastoralists to reduce morphometric effects of lean feed resources period [40 and 41].

The continual increase in the price of veterinary drugs coupled with their prolonged absences from the state-owned veterinary drug store has continued to sustain the use of ethno- veterinary practices for handling different livestock diseases and parasites [42]. Such ethno-veterinary practices incorporate medicinal plants, which have been widely used for centuries as a primary source of prevention and control of livestock diseases and parasites [43]. In West Africa, including Nigeria, farmers use traditional methods of curing livestock diseases and parasites because they are readily available and at cheaper rates [44, 45 and 46].

III. Cattle Physiological Parameters

Body temperature of cattle

Body temperature is the degree of heat of a living body [4]. Attempts to measure body temperature of cattle have been made at various anatomical locations including rectum, ear (tympanic), vagina, reticulum-rumen and udder (milk) [47]. An animal's temperature is actually the result of the balance between heat produced by the basal metabolism and muscular activity of the body, and the heat lost from the body [48 and 4]. Approximately 85% of heat loss is through the skin, while the remainder is lost through the lungs, digestive and urinary secretions [49]. The actual regulation of body temperature is accomplished mainly through thermoregulatory centers located in the brain. An animal's abnormal temperature may play a part in the veterinarian's ultimate diagnosis of a disease, and the visual symptoms of abnormal temperature are often the first noticeable clue the owner may detect [50 and 51]. When an animal's temperature is above normal limits, it's considered to have a fever; if it's below normal, it's called hypothermia [52, 7 and 8].

Domestic animals do not have constant normal temperatures and considerable variations will be found in the temperature of normal animals under different conditions. In general, animal temperatures will vary, depending on physical activity, stage of pregnancy, the time of day and environmental surroundings [47]. When the body temperature increases by at least 1°F over the normal upper limit, the animal is considered to have a fever. In most fevers, the temperature usually rises rapidly, reaches a peak, and then falls to a lower level. Generally, the height of the temperature indicates the height of the fever. Usually, the temperature never exceeds 107°F in cows even in severe infectious diseases [49]. However, in all animals suffering from heat stroke, the temperature may exceed 110°F. Although the measurement of temperature is one of the most characteristic and reliable methods to judge the degree of fever, it does not always have a direct relationship in animals, especially in cattle. One must, also, consider other symptoms, such as chill, uneven distribution of the external temperatures, pulse and respiration rates, appetite, digestion, morbidity, etc. Subnormal temperature (hypothermia) may or may not indicate disease. It occurs in a variety of ailments, such as chemical poisoning, indigestion, and calving paralysis. Subnormal temperatures are much less frequent than fever temperatures [49].

Body Temperature when properly used, can be a good indicator of illness. A greater incidence of calf illness can be identified using body temperatures rather than visual observation alone [50 and 51]. One common rule of thumb in beef cattle operations, is to designate cattle with rectal temperatures of 104° Fahrenheit or greater as sick. Body temperature rises in cattle infected with a disease-causing organism as the immune system begins to fight the infection. Some untreated cattle overcome infection and recover, while others suffer elevated body temperatures and show other signs of illness. In cattle that begin to succumb to disease, clinical signs worsen and body temperature eventually falls well below normal, creating a dangerous health situation. Early detection of elevated body temperatures and rapid recognition of clinical signs of illness are important for effective treatment of sick cattle [49].

To use body temperature properly as a measure of illness, it is necessary to know what is "normal." Unfortunately, normal temperatures for cattle rise during the day. Cattle producers must consider this when deciding when to use body temperature as an indicator for pulling sick cattle [52]. Cattle do not maintain body temperature in a tight range as humans do. Unlike humans, cattle expel body heat primarily through respiration rather than sweating. In fact, body temperature in cattle follows a daily pattern where there is a period of increasing heat load and rising body temperature followed by a period of heat dissipation and falling body temperature. Cattle body

temperatures rise during the day rather than the animals spending energy to get rid of the heat. Minimum body temperature usually occurs early in the morning, then steadily increases during the day [48]. The heat load built up during the day is dissipated at night such that body temperature falls gradually during the night, reaching a daily low early in the morning. It, also, occurs in controlled environments with a standard temperature, so factors other than the outside temperature have a significant influence on cattle body temperature. Feeding, activity level, solar radiation, and humidity also influence cattle body temperatures. Acute elevations in body temperature occur directly after feeding or exercise. Fevers are identified more accurately when body temperatures are at their daily lows [53]. For proper identification of sick cattle, make sure that body temperatures are not taken too late in the day when false positives for illness might occur. While working cattle in the late evening may seem like a good idea, cattle generally need several hours past sundown to dissipate heat and cool down from an extremely hot day. It is critical to take temperatures before mid-morning [54]. Producers measuring cattle temperature in the afternoon, even on a cold day, and letting cattle stand around for three or four hours before processing may identify cattle for treatment that are actually healthy [52and 54]. Be careful to minimize exercise and stress just before measuring temperatures. Cattle should never stand for more than 20 minutes in alleyways or chute of handling facilities before temperatures are taken. Once in the chute, measure body temperatures immediately. It may be necessary to divide cattle into small groups that can be worked in a reasonable amount of time instead of trying to work the entire group at once.

Temperature is valuable for monitoring animals, but core body temperatures are inherently difficult to obtain, and rectal temperature only approximates core body temperature. Because restraining animals to manually collect rectal temperatures may cause stress that alters those temperatures, a reliable method with no human intervention is likely to provide a more accurate measure [51]. Attempts to measure body temperature of cattle have been made at various anatomical locations including rectum, ear (tympanic), vagina, reticulum-rumen, and udder (milk) [55]. Rumen temperatures have been demonstrated to be effective measures of core body temperature. The Bella Health System (BHS, Bella Health Systems, Greeley, CO), formerly marketed in an earlier version as MaGiiX™ Cattle Temperature Monitoring System (CTMS, MaGiiX Inc., Post Falls, ID), utilizes RF identification (RFID) technology within a rumen bolus, where a panel reader is placed at a parlor entrance or exit, and a software package to collect, analyze, and view data is also installed. In many parts of the world, body temperature is measured with a clinical Fahrenheit thermometer. The thermometer has a scale ranging from 94° to 200°F, and each degree is divided into fifths. The procedure for taking an animal's temperature is: (a) shake the mercury column into the bulb end of the thermometer; (b) moisten or lubricate the tube; and (c) insert the bulb end through the anus into the rectum. Insert the full length of the tube into the rectum, and leave the thermometer in the rectum for about 3 minutes [50]. But recently digital thermother is used to measure rectal temperature of cattle with ease [53].

Respiratory rate of cattle

Respiration is the act of breathing, or taking in oxygen, using it in the body tissues, and giving off carbon dioxide [53 and 49]. The respiratory system is frequently subjected to primary and secondary disease, so stock owners must consider the area affected when an animal is not normal. A long list of serious diseases that affect all classes of farm animals, eventually, spread and settle in areas of the respiratory system. Respiration consists of inspiration, or the expansion of the chest or thorax and expiration, or the expulsion of air from the lungs. In examining respiration in an animal, check movement and sound at the nostrils and in the chest area [49]. Give attention to the following factors: Rate (number of inspirations per minute), Depth (the intensity or indication of straining), Character (normal breathing involves an observable expansion and relaxation of the ribs (costa) and abdominal wall). Any interference in breathing that may show more or less effort in either of these areas affects the character of the breathing [53]. Rhythm (change in duration of inspiration and expiration), Sound (normal breathing is noiseless except when the animal is exercising or at work). Snuffling, sneezing, wheezing, rattling, or groaning may indicate something abnormal for instance, dyspnea (labored or difficult breathing). Variations in rate of respiration can be caused by many factors including body size, age, exercise, excitement, environmental temperature, atmospheric conditions, pregnancy, and fullness of the digestive tract. If variations in respiration rates are encountered and environmental conditions are suspected as being a possible cause, it's a good idea to check the rate of two or three other animals for comparative purposes [53].

In observing the respiratory system of an animal, begin at the nostrils and work rearward. Note anything abnormal in respiration, breath, nasal discharge, nasal cavities, sub-maxillary lymph nodes, cough, larynx and trachea, surface of thorax (chest), and ausculation of thorax (sounds in the chest) [49]. Although the average stock owner is neither trained nor equipped to examine all these areas, he can make some intelligent observations concerning many of them. Respiration rates (RR) are measured by manual observation using a stethescope and stopwatch to count uninterrupted flank movements [53]. The normal respiratory rate in mature cattle at rest ranges from 10 to 30 breaths per minute [53]. Any deviation from the normal respiratory rates is frequently attributed to primary and secondary disease in cattle. Many diseases that affect all classes of farm animals spread and settle in areas of the respiratory system [7and 8].

Pulse Rate of Cattle

The pulse may be defined as the rhythmic, periodic thrust felt over an artery in time and rhythm with the heartbeat. The important factors to note in taking the pulse are: frequency, rhythm and quality [56 and 49]. Frequency is the number of heart beats occurring in one minute and is

measured by the use of a stethescope and stopwatch. Rhythm typifies a normal pulse seen in a series of rhythmic beats that follow each other at regular intervals. Quality is the tension on the arterial wall; it is an indication of the volume of blood flow [57]. Pulse rates can be palpated in superficial arteries when they are in soft tissue and can be pressed against a hard or bony structure. To determine the rate accurately, count the pulse for one full minute. Judge the rhythm and quality by alternating pressure on the artery for another full minute [56]. The pulse in cattle and horses can be felt in approximately the same location: where the external maxillary artery crosses the lower edge of the mandible, just in front of the masseter muscle. In horses, pulse may, also, be taken on the inside of the forearm (radial bone), where the radial artery travels down the bone. In sheep and goats, the saphenous artery, which runs down the inside of the hind leg, is the most accessible location [56]. In swine, the pulse cannot be felt at all. With this animal, the heart itself must be palpated directly. The normal pulse frequency varies in different species and individual animals. Age, size, sex, breed, atmospheric conditions, time of day, exercise, eating, and excitement are all factors that influence variations in the pulse rate as described by [58]. The normal pulse rate of cattle ranges from 40 to 70 beats per minutes and any deviation outside this calls for investigation [59].

Heart Rate of Cattle

Heart rates are measured by feeling the pulse, listening to heart tones, using electrocardiogram (ECG), Polar Sport Tester (PST) and telemeter methods [57]. The heart frequency, which tells how animals feel, can also be analyzed by using an implanted transmitter and the animal's heart rate and temperature can be recorded by using a special receiver [56]. The heart rate can be affected also by the measuring equipment and by the manner of measuring [56]. Deviation from the normal 50 to 60 beats per minute indicates stress and disease condition which should be attended to.

IV. Conclusion and Recommendations

It is important for a farmer to know the normal values of these physiological parameters to enable him take proper management decisions. These physiological parameters are good indicators of nutritional and health status of animals. Calving ease increased with age, parity, health and body condition score of a dam. Poor body condition score also affect rectal temperature, respiratory, pulse and heart rates. It is also associated with reduced income per cow, increased post-partum interval, weak calves at birth, low quality and quantity of colostrum, reduced milk production, increased dystocia, and lower weaning weights. Farmers should watch closely for any deviation of these physiological parameters from the normal values and should able to take appropriate action when abnormalities are observed.

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