Objective Studies in Bovine Conformation

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Introduction

Traditionally the conformation of cattle has been evaluated subjectively by lay individuals. Over the years this has lead to the selection of shape and size on the basis of aesthetics rather than "functional efficiency." The term "functional efficiency" is used by Bonsma (1973) and is best used when conformation is related to factors of economic importance such as fertility, susceptibility to disease, production, calvability and longevity.

Review of the Literature

Kempster et al. (1982) point out that the visualization of conformation is influenced by fatness. Fisher et al. (1980) show that while human judgement plays an important part in choosing beef animals for various purposes, the skills to evaluate conformation with consistent accuracy is shared by a limited number of individuals. Bonsma (1973) espouses the cause of "functional efficiency" and was able to demonstrate a truly remarkable skill in his ability to evaluate beef cattle. It can be argued that many who claim superiority in the judgement of conformation are influenced by tradition, current fashion or even personal whim; therefore consistency between individuals is unreliable. The European Association of Animal Production Working Party on Beef Carcass Evaluation[7] offers two definitions:

a) MUSCULARITY: Thickness of muscle in relation to skeletal size.

b) CONFORMATION: Thickness of muscle and fat in relation to the overall appearance of the animal.

These definitions can be applied to the living animal as can the term SHAPE which is quoted by Cook and Newton (1985) in their evaluation of the Milk Marketing Board Scheme for "Scoring" Beef Shape.

The Holstein-Friesian Association of America uses a "type" classification system as an organized approach to breed improvement. Judging type requires skill and experience, but it is a subjective process. A more objective system is adopted by the Ontario Ministry of Agriculture and Food which stresses the importance, in dairy heifers, of certain measurements.

Many research workers are using measurements to study the correlation between body measurement and production,[3,9] body weight,[4,10,11] and growth.[1,4,12]

The exact points between which measurements are made are often not defined or differ from worker to worker. It has not been possible to discover any evidence of generally accepted "standard" criteria nor has it been possible to find evidence that establishes than manual methods of measurement are accurate and/or repeatable.

The Development of a System to Evaluate the Shape and Size of Cattle

System Design

The system is based on the transfer of information from a 35 mm transparency illustrating the subject to an IBM compatible computer. In anticipation of taking the photograph, certain anatomical locations are identified with paint. The hooves are photographed, unmarked, both in lateral and posterior perspective. The photographs are projected onto a digitizing pad from which data is transferred to the computer in numerical form.

The computer transforms the numerical data into body measurements and joint angles and places them into a data file which can be accessed by the system. Separate files are maintained for other data relevant to each animal and the herd or group of animals with which they are associated. This data is entered from the keyboard.

Once an animal is on file, many separate conformation entries may be entered without further additions to the animal statistical data. The conformation data entry starts with the operator specifying an animal (already contained in the database) and supplying an exam data for this conformation entry.

Three different methods of outputing data are available with the system.

1) A single animal, single conformation "exam"—reports and/or prints the body "shape and size" values as follows:

a. Body length
b. Loin height
c. Withers height
d. Shoulder height
e. Chest depth
f. Pelvic length
g. Thurl/Hook length
h. Femur length
i. Tibia length
j. Pelvic inclination
k. Internal pelvic angle
l. Hock angle
m. Hoof length
n. Toe/heel height ratio
o. Hoof width
p. Solear surface area
q. The hook width is measured with special calipers

The report will show the field averages for animals of the same breed, sex, and age.

2) A single animal, two exam difference report: Reports and/or prints the changes in each field during the elapsed time between two exams. It also prints the average changes for animals of the same breed, sex, and age.

3) An average table can be printed. It shows the averages for all the conformation fields for all breeds, sexes and age groups.

Animal Marking

The following are recommended a technique for locating anatomical points for marking an animal and from which measurements may be taken.

1) Tuber Ichii (Pin). The medial spine is located with the index finger. The lateral spine is then palpated with the thumb. This technique is useful in fat animals. The lateral spine is used because a mark placed on the medial spine cannot always be seen in a photograph.

2) The great trochanter (Thurl). In fat animals the trochanter can usually be palpated when the animal changes weight on the limb. Spread the fingers around the probable area of the trochanter, cause the animal to shift weight and a slight depression around the trochanter can be detected with the finger tips. The mark is made on the estimated center of the trochanter.

3) The Tuber Coxae (Hook). The most lateral and ventral spine is marked. It should be noted that "loin weight" is measured at the sacrolumbar articulation which is defined as being above the lateral spine of the tuber coxae.

4) The Femorotibial articulation (stifle). Place the index finger in a depression on the medial aspect of the intermediate patellar ligament. Bring the thumb around the fold of the flank to find a point that is contralateral to the index finger. Mark this point. These positions are easily located in the relaxed animal or it may be necessary to alter the position of the limb in order to achieve the best results.

5) The calcaneous is usually marked. Although obvious in most animals, marking the point is often helpful during the process of digitization.

6) On the distal and lateral aspect of the tarsus a protruberance may be palpated. Marking this point serves as a guide during digitization. The dorsal surface of the limb level with this tubercle provides a consistent location for the angle of the hock.

7) The Olecranon (Elbow). This point is difficult to identify if the coat over the elbow is the same as that of the thoracic wall.

8) The tubercle of the humerus (Point of the shoulder). This is the most cranial portion of the shoulder joint.

Photographic Requirement

Several mandatory rules must be followed for the production of photographs consistent and acceptable to the system. For the "main body" slide, the following rules must be observed.

1) The sagittal plane of the animal must be parallel to the film plane of the camera. The lens to nose and lens to tail distance are equal.

2) A tripod head with a leveling device must be used.

3) A meter (or longer) scale must be placed in the picture over the sagittal plane of the animal. The animal identification (tattoo), lens length (mm) and date must be recorded for use when digitizing.

4) The image should be as large as possible without clipping any of the animal and must be centered in the view finder.

For the hoof slides the following rules must be observed:

a. Lateral and posterior views of the hoof should be taken with the camera located no more than 30 cm above the ground. In practice a 200 mm macro lens is the safest for an operator to use.

b. A ten centimeter scale should be included on the picture and placed at the plane at which mea-

surements are to be taken. The identification of the animal and date should also appear on the scale.

c. The vertical plane through the hoof must be parallel with the film plane of the camera.

Testing the System

1) Comparison of manual and calculated values
The skeleton of a cow was marked, photographed and the measurements of all the conformation fields recorded using a measuring tape. The photograph was then digitized and the calculated values compared with the manual measurements. The calculated and actual measurements agree to within an error of less than 2.76%.

2) Repeatability—single operator
Each of three dairy cows are marked at the usual anatomical points by an experienced operator and photographed. The marks were erased and the procedure repeated with each of the three animals on ten occasions. The repeatability and accuracy of an experienced operator was found to be high, on average the error margin was found to be 4%.

The average error to one person continually digitizing the same slide was .66%.

3) Repeatability—multiple operators
Three cows were photographed by ten different people and the results digitized on the system. The error margin increased to an average of 7.5%

4) Animal Stance Variation
Minor variations in stance did not affect the results noticeably. Major variations of stance as may be encountered with fractious animals will cause inaccuracies to occur.

5) Manual measurements
Ten cows were measured by two people using conventional measuring devices and the results compared one with the other. Variations of about 4.0% were encountered. It was also noted that linear measurements using a tape from pin to shoulder followed an arc around the animal's body thereby making the measurements significantly more than produced by the photographic system.

Conclusions

An objective system for measuring shape and size has been described. It has been developed in order to permit conformational traits to be identified that may be predisposing causes of lameness or be associated with the functional efficiency of an animal.

The landmarks and dimensions employed are recommended as the basis for an international system. The system recommended is based as far as possible on the work of other investigators.[12]

It would be inaccurate to suggest that the measurement of a bone by using the system would represent its precise length. The measurements derived from the system are, however, consistent in that they can be used to compare the same measurements in different animals.

In early stages of the work measurements of the hoof and thickness of the metatarsus were included. It has been discovered that a small structure in a photograph cannot be measured accurately by this system. Accordingly, it is necessary to take separate photographs of the hoof.

It was found that inaccuracies could occur as the result of different postures adopted by the animal. The angle of the pelvis to the horizontal, the angle of the hock, the body length and height at the withers can show discrepancy depending on the stance of the animal. When accuracy is critical, three or more photographs of the same subject taken at the same time are desireable. The animal should be moved and repositioned between each photograph. Photographs of animals showing unsuitable stance can be discarded by the operator.

The system is quite easy to use but skill and experience is needed to produce consistently good results. This is not to suggest that the operators need advanced photographic knowledge but they must meticulously observe the guidelines. With experience, photographs can be produced in less than ten minutes. Accuracy will deteriorate if it is necessary to employ a severity of restraint that will upset the posture of the animal. The system is intended to be a tool and there is no intention of setting standards for confirmation, this is the domain of the industry.

Mathematically the system is accurate for all practical purposes. In practice, the skill, knowledge, experience and patience of the person taking the photograph will affect the results significantly. The errors resulting from using a measuring stick and tape are no less than those encountered during the field use of the system described.

Optical illusion may be one of the weaknesses of some subjective evaluations. Objective evaluation can never replace those subjective observations that reflect the subtle hormonal balance of the animal body or some of the genetically controlled physical characteristics known to be linked to physiological strengths. The system described is only recommended as a means of supplementing subjective evaluation for specific purposes that are beyond the scope of the human eye.

Discussion

There are many misconceptions and counterproductive opinions about some of the characteristics of confor-

mation. It is known that some conformational traits predispose to certain limb diseases that result in lowered production or a reduction in the animal's useful life. Researchers have demonstrated that certain characteristics of conformation are related to the potential performance of an animal. It can be argued that an objective perspective of conformation cannot be achieved until it is possible to measure a workable number of linear measurements relatively accurately, that the measurements can be compared between workers and it is possible to evaluate joint angles. This report suggests that significant progress has been made towards developing a system that will enable workers to study conformation in a systematic and realistic manner.

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