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In Vivo
**Measurement
of Body
Composition
in
Meat
Animals**

Edited by
D. LISTER

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IN VIVO MEASUREMENT OF BODY COMPOSITION IN MEAT ANIMALS

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IN VIVO MEASUREMENT OF
BODY COMPOSITION IN MEAT ANIMALS

A workshop in the EEC Programme of Coordination of Research on Animal Production, held at the Agricultural and Food Research Council's Meat Research Institute, Langford, Bristol, UK, on 30 November and 1 December 1983

Sponsored by the Commission of the European Communities, Directorate-General for Agriculture, Coordination of Agricultural Research

P R E F A C E

This publication contains the proceedings of a Workshop held at the Agricultural and Food Research Council's Meat Research Institute, Langford, Bristol, UK, during 30 November and 1 December 1983, under the title '**In vivo Measurement of Body Composition in Meat Animals**'. This meeting was held as a coordination activity of the Commission of the European Communities' Agricultural Research Programme. This activity was the third of its kind. The first, organised by Dr B. Bech Andersen of the National Institute of Animal Science, Copenhagen, was concerned primarily with reviewing techniques (mainly ultrasonic) for describing the carcass characteristics of meat animals (Publication 524, Beretning fra Statens Husdyrbrugsforsøg, Copenhagen). Subsequently a report on the application and evaluation of ultrasonic techniques was commissioned for the CEC Beef Research Programme (Publication EUR 7640 EN).

The meeting reported here was arranged to consider the latest techniques, eg X-ray Computed Tomography, Nuclear Magnetic Resonance Spectroscopy and Neutron Activation Analysis, which are becoming increasingly important as diagnostic aids in human medicine. Much of the experience and expertise in these fields comes, consequently, from the medical world and the CEC is extremely grateful for the substantial contribution made to the meeting by medical colleagues.

In addition to enlisting such help it was hoped to have appreciable involvement from various commercial organisations responsible for the manufacture or sale of appropriate equipment, for it is known that several Member States are actively considering the purchase of suitable equipment. Unfortunately, only two companies responded positively to invitations to take part in the Workshop. Oxford Research Systems Ltd provided demonstration material and active participation via Mr Randal Rue; Siemens Ltd provided a display stand. Potential purchasers of the equipment discussed herein may recognise that applications in animal science represent a secondary and relatively small market which may not attract an appropriate interest from suppliers who will look primarily to the vast potential market in clinical medicine.

The programme was planned by Dr D. Lister and Dr C.A. Miles of the Meat Research Institute, Langford and Dr B. Bech Andersen of the National Institute of Animal Science, Copenhagen. The meeting was organised and the proceedings edited by Dr D. Lister.

The CEC wishes to thank all those who took responsibility for the organisation and running of this Workshop, who chaired sessions, prepared papers and posters, and took part in the discussion.

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SESSION I

INTRODUCTION

Chairman: David Lister

REVIEW AND UP-DATING FROM PREVIOUS MEETING IN COPENHAGEN

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One of the important research objectives drawn up by the CEC Beef Production Committee has been estimation of body composition in beef. A CEC workshop titled "In Vivo Estimation of Body composition in Beef", was held in Copenhagen 15-16th December, 1981. In total 32 scientists representing research disciplines of genetics, nutrition, carcass quality and electro-technics participated.

The workshop was divided into three sessions. The presented papers and the concluding discussion were published in the report no. 524 from The National Institute of Animal Science.

1. Practical use and experimental results of in vivo techniques.

The reviews presented demonstrated, that the use of in vivo techniques varied **greatly** between the EEC countries.

In the performance- and progeny tests of bulls subjective scoring for conformation and fleshiness is done routinely in Belgium, France, Holland, Germany and Great Britain. In Great Britain additional fat area measurements are taken with Scanogram ultrasonic equipment. Only in Denmark **is fleshiness** measured routinely by use of Danscanner measurements of M.longissimus dorsi areas.

In most countries experiments have been carried out in the field of in vivo estimation of body composition in beef, and a great number of results were summarized at the meeting.

Also, results from a CEC supported ultrasonic trial in UK and DK were presented. Five ultrasonic machines were compared in that experiment. It was concluded that the repeatability of the scanning results was highest at the 1st lumbar vertebra po-

sition and higher for fat than muscle measurements. Correlations between ultrasonic measurements and corresponding carcass cut face measurements at 1st lumbar vertebra ranged from 0.52 to 0.81 for fat area and from 0.53 to 0.71 for area of M. longissimus dorsi. The percentage of lean in the carcass was best correlated with fat measurements, whereas muscle area was best correlated with dressing percentage and lean/bone ratio. Between the machines there was only a small difference between the correlations averaged over interpreter, location and origin of cattle. Among the operators, however, there was a preference for the "Danscanner" and "Scanogram", which are specifically constructed for use on farm animals.

It was pointed out that those starting scanning work should know the anatomy of the relevant parts of the animal, receive training in the use of the equipment, ensure a good back-up service and arrange periodic checks of the accuracy of their measurements.

2. Potential use of in vivo techniques and their limitations.

Two papers on the potential use of in vivo techniques for breeding purposes were presented. Dr. King grouped in his paper the discussion of alternative prediction methods under the headings: i) practicability, ii) portability, iii) cost and iv) public acceptability. Dr. King also discussed two alternative methods to performance testing comprising sib testing or individual testing followed by gamete storage. Bech Andersen presented results on the use of ultrasonic measurements in a performance test selection, and he discussed the expected difference in long term responses by selection for subcutaneous fat layer vs muscle area.

Dr. van Es discussed the precision needed in nutrition experiments and Dr. Robelin presented results of estimation of body composition by dilution techniques in nutrition experiments.

Finally in that session Dr. Kempster discussed the use of in vivo techniques and their limitations for commercial manage-

ment and selection of cattle for slaughter.

3. Review of in vivo techniques for possible future use.

The session was concentrated on ultrasonic, computerized tomography and dilution techniques.

H.Skjervold told about the use of Computerized Tomography (CT scanning) in Norway. In a pilot experiment it was possible to describe 85% of the variation in energy content of living pigs. A Siemens CT scanner is now in use in Animal Science in Norway.

Peter Levin concluded in his paper, that the recent advances in ultrasonic imaging seems to be applicable to in vivo evaluation of body composition in beef. However, the new methods discussed, require extensive development before they can be applied to obtain valuable information relevant to animal research.

J.Robelin presented results from French experiments with dilution techniques, and he concluded that this method of measurement of body water is fairly good as long as enough blood samples and body weight recordings are made.

In a reviewing paper C.A.Miles assessed the potential and limitations of some methods not covered in previous presentations, namely density measurements, dielectric methods, X-ray or gamma radiation, hormone measurements, nuclear magnetic resonance, Potassium-40 and neutron activation analysis.

4. Concluding discussion

The participants in the Copenhagen meeting made the following conclusions:

"The papers presented in the workshop demonstrated very rapid technical development in the area of in vivo techniques. The development seems to go in two directions. One for relatively robust and simple equipment easy to apply under farm conditions; and the other for more advanced techniques to be used on testing and research stations. Examples of techniques in the first direction of development are visual assessments, body measurements and ultrasonic scanning using machines based on a relatively simple technique. Examples of more advanced techniques are dilution space of D₂O, real-time ultrasonic scanning and computerized tomography from X-ray transmission data.

New in vivo techniques have great potential use in several areas in nutrition, breeding and management. However, objectives and problems can be different. In breeding the more advanced in vivo techniques can be used in indirect selection for dressing percentage and carcass quality among performance tested young bulls. It is not unlikely that technical development will make it possible in the future to follow the development of various vital organs, the deposition of energy and the reaction on different fasting/refeeding systems. If this proves possible, it will increase the importance of in vivo techniques drastically. In nutritional experiments there is a great need to obtain more information on growth and development, including the possibility of being able to follow the continuous changes in histological and chemical body composition during feeding experiments. A fully developed in vivo technique could possibly be a substitute to the very costly procedure of serial slaughtering.

In testing and comparisons of various in vivo techniques, emphasis must be concentrated on factors like their value in predicting the components of interest, as well as their repeatability and reproducibility. The reference basis in such comparisons will depend on the objective of the technique. Preliminary analyses have shown that some techniques have very favourable cost/benefit ratios and that considerable investment in equipment can sometimes be justified. However, further analyses are necessary, based on various assumptions.

Further development and experiments with in vivo techniques should be given high priority in the near future. However, development and testing is expensive and, since the results are of general interest in many countries, close co-ordination and co-operation between countries is recommended. When new techniques are tested, it is considered important to build in comparisons with one or more previously established in vivo methods. It is also important to follow very closely developments in human medicine.

The workshop recommends that a seminar is arranged on the use of in vivo techniques in breeding and nutrition experiments. Such a seminar could give further progress in the area and also add to the international co-ordination. It was agreed that a multidisciplinary seminar would be the most appropriate. The seminar should concentrate especially on further elucidation of problems and prospects of in vivo techniques in relation to breeding and selection, and of the role of in vivo techniques in relation to physiological studies and also on cost/benefit analysis. Experts on the use of in vivo techniques in human medicine should be invited to take part in the seminar and give a review and evaluation of the use of the techniques in their field".

In the last two years promising results have been obtained both in the technical development and in the practical application of various techniques to use in animal science. Among experts in genetics, nutrition etc., we can see an increasing interest in use of in vivo techniques as tools in the experimental work. It means that the topic on the program today and tomorrow is very timely, and therefore we are looking forward to a lively discussion and a fruitful exchange of ideas and new knowledge at this Langford CEC Workshop.

THE MEASUREMENT OF BODY COMPOSITION -
OPPORTUNITIES AND REQUIREMENTS IN ANIMAL PRODUCTION

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ABSTRACT

Such new techniques as Computed Tomography and Nuclear Magnetic Resonance Spectroscopy have been shown to measure body composition in live animals with much greater accuracy than all other methods applied presently in animal breeding. Extremely high costs, limited mobility and suitability for larger farm animals of the equipment presently used in medicine require a close consideration of potential future applications in animal production, before large investments are suggested. I conclude that the new techniques would have great potential in future animal breeding programmes if

- (1) their higher accuracy leads to substantially greater heritabilities for live animal measurements,
 - (2) live animal measurements could replace all sib and progeny carcass informations completely,
 - (3) applied by large enough centralized breeding programmes which can distribute costs and additional progress over a large pyramid of customers.
- In the face of such prospects it seems to be highly advisable to set up a few pilot research units in the EEC in order to find out whether the above expectations are realistic and how the techniques can most efficiently be applied in routine animal breeding programmes.

INTRODUCTION

Exact measurements of body composition require such expensive machinery that at present it is only applied in human medicine. It has, however, been shown that such methods as Computed Tomography (CT) and Nuclear Magnetic Resonance Spectroscopy (NMR) in principle could just as successfully be used to measure body composition in smaller farm animals (SKJERVOLD et al., 1980). More progress reports will be presented here and it may be possible to examine soon large farm animals, such as cattle and even horses, if that seems to be desirable. On the other hand enormous costs are still involved and one cannot see how these could ever be reduced into amounts which animal breeders would be prepared to invest for measuring body composition. Before investing a lot of experimental and financial resources into adapting the new methods to animal breeding purposes - and that would certainly be necessary if they are to be effectively utilized in animal breeding routine work - we should very carefully discuss the following questions: