

PROCEEDINGS OF THE NUTRITION SOCIETY

The Two Hundred and Seventy-third Scientific Meeting (One Hundred and Ninth of the Scottish Group) was held in the James Weir Building, University of Strathclyde, Montrose Street, Glasgow C1, on 8 November 1974

SYMPOSIUM ON 'THE NUTRITION OF NEW FARM ANIMALS'

Conventional and unconventional farmed animals

By K. L. BLAXTER, *Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB*

What is conventional is that which is sanctioned and currently accepted by tacit agreement. What is unconventional is a simple obverse. Such a definition implies that a conventional source of food varies with the culture of a people and is not static in time. Some examples of this relating to animals as sources of food are of interest. In China in the 1920s puppies of pariah dogs were fattened on rice, and killed when 9 months old. The meat was cooked with dried mushrooms, preserved bean cake, native onion, a little ginger and water chestnuts (Epstein, 1969). Earlier accounts by Hosie (1901) refer to thousands of dog farms in Manchuria each rearing tens to hundreds of dogs, largely, but not entirely, for their meat. Though the camel is largely kept for transport, and to a limited extent for draught, Leese (1927), in a little-known book, refers to the rearing of camels in Somalia and Kenya purely for meat. The animals were usually castrated at about 3 years of age to favour their fattening and to impart a tenderness in their meat. Incidentally, camel ticks were collected assiduously at that time to feed another domesticated species, the hunting falcon. When Captain Cook, on 2 June 1773, landed the first goats in New Zealand at Queen Charlotte Sound, it was with the idea that they should provide food for the early settlers. Only later was the incredible propensity of the goat to eat virtually anything made use of by regarding it as a first colonizing species to help clear land of scrub and make way for sheep. It was escapers from these 'farmed' stocks that led to the establishment of the wild goat population of that country (Wodzicki, 1950). The horse has long been a meat animal in the Urals, in Belgium and indeed in France, where research programmes are now being designed to examine and exploit its meat-producing propensities.

People in Britain would, for the most part, not consider these domesticated species (dogs, castrated camels, goats and horses) as usual or preferred meat animals. But then the British have evidently always been a rather conservative race, for Julius Caesar commented with some surprise in 'De bello gallico' that they would not eat geese. Describing the arbitrary nature of the selection of some species

and the rejection of others as sources of meat Sir Thomas Browne wrote in 1646: '*Aristotle* and *Albertus* commend the flesh of young Hawks: *Galen* the flesh of Foxes about Autumn when they feed on grapes: but condemneth Quails, and ranketh Geese but with Oestriges: which notwithstanding present practice every table extolleth. Men think they have fared hardly if in times of extremity they have descended so low as Dogs: but *Galen* deliverth that young fat and gelded, they were the food of many nations: and *Hippocrates* ranketh the flesh of Whelps with that of Birds: who also commends them against the spleen, and to promote conception. The opinion in *Galen's* time which *Pliny* also followeth deeply condemned horse-flesh and conceived the very blood thereof destructive; but no diet is more common among the *Tartars*. This may seem only an adventure of northern stomachs yet as *Herodotus* tells us, in the hotter clime of *Persia* the same was a convivial dish' (Browne, 1646). All the species referred to by Sir Thomas were at one time or other domesticated ones. The fox is no exception, for there is evidence from Neolithic sites in Switzerland that not only was the fox eaten but lesions of the limb bones in remains suggest that they were kept in captivity (Hauk, 1950). An analogous injury is that described in Roman times when doves kept in columbaria had their legs broken, allegedly to encourage fattening by reducing movement (Varro, *De re rustica*, 28 BC). Furthermore, there is some evidence that a number of species which we now regard only as wild animals were at one time domesticated to some extent. The most remarkable example is the striped hyaena (*Hyaena hyaena* L.). A series of carvings from tombs of the Old Kingdom (2750–2500 BC) show the shepherding of hyaena, the restraint of the animal, the casting of it on its back, the tying of its limbs and the process of stuffing it with roast goose or duck. A fattened hyaena was evidently a delicacy. Zeuner (1963) admittedly is not convinced that this process constituted true domestication, in that records do not survive to indicate whether these hyaenas bred in captivity. A further remarkable example was the partial domestication of the European hare (*Lepus europaeus*) by the Romans. This species was kept in gardens (leporaria) but in view of the very considerable difficulty in inducing hares to breed in captivity it is unlikely that true domestication occurred.

At the present time there is some evidence that the number of species we conventionally regard as sources of meat is falling. In the USA and Canada the importance of the sheep as a source of meat has certainly declined to the point that it has become a luxury food, comparable in fact to the dormouse which, by a Roman law (*Lex Aemilia*) became a prohibited delicacy in 78 BC. Cattle, pigs, chicken and turkeys provide the staple meats in North America. In the UK there is some evidence of a similar trend, for demand for mutton and lamb is falling, and that for poultry meat has soared to the extent that it is now the preferred source of meat. Yet in Norway, poultry meat production, comparable to our broiler industry, has not developed, since Norwegians do not like poultry meat, and there is still a small meat industry based on the fattening of goat kids (Central Federation of Cooperatives, 1972).

There is, of course, no doubt that animals other than domesticated ones contribute very considerably to the food supply. The most obvious examples are fish, crus-

taceans and the sea mammals which are hunted rather than farmed. In addition, there are a very large number of species of land mammal, bird, reptile, amphibian, mollusc and insect larva which are hunted, caught and eaten. Indeed, the list of species which now or in the past have been eaten with more or less relish by man must be considerable. Rather than dwell on the departures that we can note in other countries or at other times from our restricted conventional attitudes to food animals, it is perhaps more useful to question that very conservatism. Out of the many thousands of known species of land mammal and bird, we have under current domestication and use as sources of food by some peoples only about thirty. They consist of nine birds: hen, turkey, duck, goose, swan, guinea-fowl, peafowl, pigeon and ostrich; and twenty mammals: horse, ass, Arabian and Bactrian camels, llama, alpaca, vicuna, European ox, zebu, buffalo, yak, gayal, banteng, sheep, goat, reindeer, pig, rabbit, guinea-pig and dog. The number of domesticated fish used as food is two: the carp and goldfish. This paucity of domestication has been commented on by many, commencing with Huntingdon's pioneer analysis (Huntingdon, 1925), and understandably there has emerged a considerable interest in the possibility that other species of animal and bird might have some advantages over those which we at present farm.

Perhaps the most interesting plea for the unconventional animal was made by Hutchinson (1954), but has not, to my knowledge, been further explored. Hutchinson wrote: 'The tendency of the poultry industry is to control more and more closely the climate in which fowls live by housing, artificial lighting etc. If this process is continued man will end by substituting ectothermic for endothermic heat regulation. . . . The fowl in particular competes with man for cereal grains and so it would seem only logical eventually to substitute a poikilotherm which does not burn large quantities of food to maintain its body temperature. Amongst poikilotherms only reptiles have the appropriate body size to fill the niche occupied by fowls in the human ecosystem and the Chelonia at least produce eggs and meat which have been prized by man since time immemorial . . .'. In today's context of diminishing fossil fuel supplies and their effect on food production (Leach, 1974) together with prospects of climatic change, Hutchinson's suggestion is not necessarily outlandish; after all, at one time 48 million Amazon terrapin eggs were collected for their oil.

Comparisons of food utilization by poultry with that of a poikilothermic species, the carp, have been made by Nijkamp, van Es & Huisman (1974) and these do not suggest great advantage for the poikilotherm. Their comparisons, given in Table 1, showed first that the daily maintenance need of energy by carp was one-fifth that of the broiler chicken, values being expressed per unit of metabolic size (body-weight^{0.75}). The rate of growth in terms of daily energy retention per unit metabolic size by carp was also only about one-fifth that in the chicken. The efficiency with which the total food energy consumed by the carp growing from 40 g to 80 g was retained in the body was maximally 27%. With the broilers efficiency averaged 30% over the normal growth period, suggesting no great advantage of the poikilothermic species, which incidentally were kept in tanks at 23°. Further aspects of the cultivation of poikilothermic species (fish and crustacea), where there are great advantages to be

Table 1. *Food energy utilization by chicken and by carp (Cyprinus carpio)**

Utilization of energy for:	Broiler chicken	Carp	Ratio, chicken : carp
Maintenance of weight (MJ/kg ^{0.75})	355	75	4.7
Daily growth (MJ/kg ^{0.75})	447	92	4.9
Gross efficiency (%)	27-33	27	—

*From Nijkamp, van Es & Huisman (1974).

gained in terms of economy of human effort by farming these animals rather than hunting them, are given by Cowey (1975) and Walker (1975).

A current interest in many parts of the world is the possibility that some of the larger wild herbivorous mammals might be the basis of new farming systems. Investigations of the domestication of the eland in Rhodesia (Posselt, 1963; Roth & Osterberg, 1971) and in Russia (Treus & Kravchenko, 1968), of the capybara in Venezuela (Gonzalez Jimenez, 1973) and of the red deer in Scotland (Bannerman & Blaxter, 1969; Blaxter, Kay, Sharman, Cunningham & Hamilton, 1974) are examples. A distinction must be made as between game cropping and farming. Game cropping is simply the rationalizing of a hunting economy in which information about the population dynamics and ecological relationships of a species or a group of species is used to design culling systems which may be of some sophistication. The harvesting of the animals for meat is characteristically dispersed. Farming represents a more direct manipulation, usually of a single species in which slaughter or the collection of animal product (milk or eggs) is central, and thus presupposes a stock which can be herded. The reindeer herds of northern Scandinavia, although they and their herdsmen have a nomadic existence, are by this definition just as much a farmed species as are the herds of dairy cows in the UK. The great advantage of farming over game cropping is that control of disease, improvement of nutritional status and genetic manipulation of the animals are far more readily carried out when the stock has those characteristic behavioural patterns we associate with a domesticated one.

There is evidence that these unconventional animals have attributes which might make them more useful species in some habitats than are conventional herbivora. The ecological arguments have been summarized by Kay (1970) and by Kyle (1972). In addition, there is some evidence that a greater amount of meat can be obtained from an area when an unconventional animal is used. Thus Gonzalez Jimenez & Parra (1973) calculate that capybara could, on the basis of their measurements, produce more than four times as much carcase per ha as cattle. In addition, most of the ungulate species selected for systematic game cropping or for farming are characteristically lean when compared with cattle and sheep. This is not only true of the African animals studied by Ledger (1968) but equally applies to temperate ones. Table 2 compares broad aspects of the composition of red deer carcasses and those of cattle and sheep (Blaxter *et al.* 1974).

Table 2. *Body composition of red deer, cattle and sheep**

Species	Body-weight (kg)	Carcase (g/kg body- weight)	First-quality meat (g/kg live weight)	Chemical fat in carcase minus dissected fat (g/kg)	Dissected fat (g/kg dressed carcase)
Deer (6 months)	48	591	331	65	62
Deer (3 years)	58	534	307	87	61
Cattle	500	550	251	221	117
Sheep	41	471	182	223	219

*From Blaxter, Kay, Sharman, Cunningham & Hamilton (1974).

The table shows not only the low fat content of the carcase of the deer but also its marked superiority over cattle and sheep in terms of the amount of first-quality meat in the total body. The low proportion of first-quality meat in the sheep may well account for the discrimination against the sheep as a meat animal referred to previously; certainly a low fat content in meat is an attribute of meat which nowadays has considerable consumer appeal.

Enthusiasm for the apparent advantages of species other than the conventional ones as potential sources of food must be tempered by a consideration of the many problems involved in the whole process of setting up a new animal industry, and in some instances of promoting foods unfamiliar to many people. While farming techniques can be and have been devised which result in a sustained productivity, farming of any animal presupposes a complex of additional services, facilities, processing plants and marketing organisations. These include provision for the buying and selling of breeding stock, for the control of any communicable disease in them, arrangements for transport, slaughter, processing of the carcase and packaging the meat for sale. Meat is not the sole product; markets must be found for hides and for the inevitable waste products. New products may have to be developed from those parts of the carcase which are not readily marketed in an undisguised form. In addition, the markets themselves have to be developed and on occasion consumer prejudices allayed.

When the new technology entails producing, under farming conditions, a food which is already well known and accepted as the product from a wild hunted species the problems are not great. The rainbow trout is a familiar food and the development of new methods of producing it merely augments supply. In some instances familiarity works in the other direction and the slow development of the broiler rabbit industry may well reflect the aversion of many people in Britain to rabbit meat following upon the decimation of wild stocks in the 1950s by myxomatosis. Remembrance of dying rabbits on roads lingers long in the public mind. With unfamiliar new species it can be envisaged that because of the many restraints imposed by the absence of an infrastructure of service and marketing and the conservatism of our food habits, the time interval between the first demonstration of a successful farming system and the emergence of a new food industry could well be long. It seems likely that during this phase of development, food from these species will become luxury

items in the diet analogous to the place occupied by the turkey some 40 years ago. Nevertheless, delays of such a magnitude in creating new farm animals are not great when it is considered that the first domestications of food animals took place more than 7000 years ago and probably took many centuries to complete, and that we have in large measure rested on those past achievements ever since.

REFERENCES

- Bannerman, M. M. & Blaxter, K. L. (1969). *The Husbanding of Red Deer*. Aberdeen: Highlands and Islands Development Board & Rowett Research Institute.
- Blaxter, K. L., Kay, R. N. B., Sharman, G. A. M., Cunningham, J. M. M. & Hamilton, W. J. (1974). *Farming the Red Deer*. Edinburgh: HM Stationery Office.
- Browne, T. (1646). *Pseudotoxica Epidemica, or Enquiries into Many Received Tenets and Commonly Presumed Truths*, 1st ed. London: Edward Dod.
- Central Federation of Cooperatives (1972). *Norwegian Agriculture and its Organizations*. Oslo: A/S Landbruksforlaget.
- Cowey, C. B. (1975). *Proc. Nutr. Soc.* **34**, 57.
- Epstein, H. (1969). *The Domestic Animals of China*. Farnham Royal: Commonwealth Agricultural Bureaux.
- Gonzalez Jimenez, E. (editor) (1973). *Explotación Semi-domestica del Chiguire*. Maracay: Universidad Central de Venezuela.
- Gonzalez Jimenez, E. & Parra, R. (1973). In *Explotación Semi-domestica del Chiguire*, p. 1(b)-1. [E. Gonzalez Jimenez, editor]. Maracay: Universidad Central de Venezuela.
- Hauk, E. (1950). *Prähist. Forsch., Wien* **1**, 164.
- Hosie, A. (1901). *Manchuria and its People, Resources and Recent History*. London: Methuen.
- Huntingdon, E. (1925). *Econ. Geog.* **1**, 143.
- Hutchinson, J. C. D. (1954). In *Progress in the Physiology of Farm Animals*, vol. 1, p. 299 [J. Hammond, editor]. London: Butterworths Scientific Publications.
- Kay, R. N. B. (1970). *Proc. Nutr. Soc.* **29**, 271.
- Kyle, R. (1972). *Meat Production in Africa*. Bristol: University of Bristol Press.
- Leach, G. (1974). In *The Man-Food Equation* [G. H. Bourne, editor]. London: Academic Press.
- Ledger, H. P. (1968). *Symp. zool. Soc. Lond.* **21**, 289.
- Leese, A. S. (1927). *A Treatise on the One-humped Camel in Health and Disease*. Stamford, Lincs.: Haynes & Son.
- Nijkamp, H. J., van Es, A. J. H. & Huisman, E. A. (1974). *Publs Eur. Ass. Anim. Prod.* no. 14, p. 277.
- Posselt, J. (1963). *Rhod. J. agric. Res.* **1**, 81.
- Roth, H. H. & Osterberg, R. (1971). *Rhod. J. agric. Res.* **9**, 45.
- Treus, V. & Kravchenko, D. (1968). *Symp. zool. Soc. Lond.* **21**, 395.
- Walker, A. (1975). *Proc. Nutr. Soc.* **34**, 65.
- Wodzicki, K. A. (1950). *Bull. N.Z. Dep. scient. ind. Res.* no. 98.
- Zeuner, F. E. (1963). *A History of Domesticated Animals*. London: Hutchinson.