fodder, but the technology of this process is intricate. The product may not, therefore, reach those most in need, but the enterprise that is being shown should promote interest in the growth of micro-organisms on low-protein crops and on by-products such as molasses and straws.

Work on the production of novel proteins is hampered by the indifference or even hostility of

national and international bodies responsible for our food supplies. It will be still further frustrated unless serious effort is put into studies on the presentation and popularization of novel forms of food. This work will call for skill, tact and a broad-minded recognition of the diversity and irrationality of traditional human tastes. It is this aspect of the problem that is now in most need of support.

COMMUNICATIONS*

The Fatty Acid Composition of Adipose and Muscle Tissue in Domestic and Free-Living Ruminants

By M. M. GALE, M. A. CRAWFORD and M. WOODFORD. (*Nuffield Institute of Comparative Medicine, The Zoological Society of London, London N.W.1 and Nuffield Unit of Tropical Animal Ecology, P.O. Queen Elizabeth Park, Lake Katwe, Mweya, Uganda*)

The fatty acid composition of muscle tissue from free-ranging (*Syncerus caffer*) and domestic bovids (*Bos taurus*) differs considerably. In the free-ranging bovids there is a small amount of intramuscular fat, which contains a high proportion of polyenoic fatty acids compared with domestic bovids (Crawford, 1968). We have examined the fatty acid composition of adipose and muscle tissue of samples from free-ranging and domestic ruminants and in both cases the degree of polyunsaturation was greater in muscle than in adipose tissue.

In adipose tissue from domestic bovids the monounsaturated fatty acids dominated, accompanied by small amounts (0.2–2%) of polyenoic fatty acids. In associated muscle tissue there was a greater amount of polyenoic fatty acids, including eicosatetraenoic acid; the total proportion of polyenoic fatty acid was 0.8–6% and, as in the adipose tissue, the monounsaturated fatty acids predominated, in agreement with the findings of Hubbard & Pocklington (1968).

The adipose tissue of the free-ranging ruminant contained about 2–6% of polyenoic fatty acids including octadecadienoate and octadecatrienoate; the saturated and monounsaturated fatty acids predominated. In contrast, the muscle tissue of the free-ranging ruminants contained about 20–40% of polyenoic fatty acids including octadecadienoate, octadecatrienoate, eicosatetraenoate, eicosapentaenoate, docosapentaenoate and docosahexaenoate. The fact that in neither case did the adipose tissue contain significant amounts of polyenoic fatty acids higher than C_{18:3} suggests that the composition of adipose tissue may not reflect the proportions that are available in other tissues.

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The wide difference in the adipose- and muscle-tissue fatty acid composition in the free-living animal suggests an efficient separating mechanism for structural lipids (predominantly phospholipid) and adipose depots for energy stores (predominantly triglyceride). The smaller differences between adipose and muscle tissue of domestic animals might be explained on the basis of infiltration of adipose fat, which may represent a biologically abnormal state.

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Immunoglobulins in Sow Mammary Secretions throughout Lactation and their significance as Anti-(*Escherichia coli*) Antibodies to the Young Pig

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Under normal conditions piglets cease to absorb immunoglobulins from the colostrum after the first 24–36 hr. of life (Lecce & Morgan, 1962). The animal does not synthesize any appreciable amount of antibody before the age of 3–4 weeks (Brown, Speer, Quinn, Hays & Catron, 1961; Miller *et al.* 1962) and passively acquired antibody falls to very small amounts in the period 2–3 weeks (Sharpe, 1965; Arbuckle, 1968). It has often been suggested that antibodies in milk play an important role in protecting the young animal against enterobacteria. The protein composition of porcine milk changes rapidly in the early part of lactation (Morgan & Lecce, 1964), but nothing is known of the changes in specific immunoglobulins or their role as antibodies in the alimentary tract of the young pig.

Immunoglobulins G, A and M (IgG, IgA and IgM) were isolated from porcine serum and colostrum and antisera were prepared in rabbits for use as specific reagents for detection and quantitative measurement. The immunoglobulins account for more than

60% of the sow colostrum whey protein, and approx. 80% of the immunoglobulin is IgG. Chromatographic studies on Sephadex G-200 and DEAE-cellulose indicate that anti-(*Escherichia coli*) antibodies in colostrum are associated with IgA and IgM. However, only the IgM antibody is acquired as serological passive immunity in the neonatal piglet and this declines to small amounts in the first week of life.

During the first week of lactation, the immunoglobulin concentration of porcine milk falls to approximately one-fifth of the original colostrum concentration. These changes are most marked in IgG and IgM, which show an approx. tenfold decrease, whereas the IgA shows only a twofold decrease in this period. As a consequence of these changes, IgA becomes the predominant immunoglobulin and anti-(*E. coli*) antibody in sow milk after the first 72 hr. of lactation.

The passage of sow milk IgA and anti-(*E. coli*) antibodies through the alimentary tract was studied in young pigs with re-entrant fistulae prepared in the upper duodenum.

IgA appears in the duodenum within 10 min. of feeding, at concentrations comparable with those in the milk, and continues at similar concentrations for approximately 20 min. falling to minimum values in 1 hr.

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Interactions between the Alkaline-Earth Metal Ions and Purified Bovine Caseins

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α_{s1} -, β - and κ -Casein fractions were prepared from the milk of an Ayrshire cow by chemical fractionation and chromatography on DEAE-cellulose (Thompson & Kiddy, 1964; Thompson, 1966; McKenzie & Wake, 1961). Equilibrium dialysis was used to study the interactions of these proteins with Ca^{2+} , Sr^{2+} and Ba^{2+} ions by radioactive isotope-dilution techniques to determine metal ion concentrations. Binding varied with the free cation concentration, pH and the ionic strength of the medium. The relative order of binding capacity for the three fractions was $\alpha_{s1} > \beta > \kappa$.

Binding to α_{s1} -casein in tris-hydrochloric acid buffer, pH 7.4 and I 0.1 at 25°, increased with metal ion concentration; the protein precipitated at about 10mM-metal ion. β - and κ -Caseins behaved in a similar fashion except that κ -casein was not precipitated, even at higher metal ion concentrations. Increasing the ionic strength decreased alkaline-earth binding, but over the pH range 7–9 pH had little effect.

Analysis of the binding results at pH 7.4 shows that there are at least two classes of binding sites. This is supported by studies on α_{s1} -caseins that had been chemically modified to alter the number of ionizing carboxyl and phosphate groups. These suggested that Ca^{2+} ions interacted with ester phosphate groups of serine and threonine and that weaker interactions occurred with the free carboxyl groups of aspartic acid and glutamic acid residues.

The relative order of binding to α_{s1} - and β -caseins in tris-hydrochloric acid buffer, pH 7.4 and I 0.1 at 25°, is $\text{Ca}^{2+} > \text{Ba}^{2+} > \text{Sr}^{2+}$ and that to κ -casein is $\text{Ca}^{2+} > \text{Ba}^{2+} \geq \text{Sr}^{2+}$. Under similar conditions the corresponding order for bovine serum albumin was found to be $\text{Ca}^{2+} > \text{Sr}^{2+} \geq \text{Ba}^{2+}$.

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Measurement of Muscle Protein Turnover by Constant Intravenous Infusion of [^{14}C]Glycine

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Measurement of muscle protein half-life by constant intravenous infusion of [^{14}C]lysine has led us to believe that muscle proteins turnover at a somewhat higher rate than was previously thought (Waterlow & Stephen, 1968). It was considered advisable to compare the results obtained with a non-essential as opposed to an essential amino acid.

Male white rats weighing about 100g. were infused with a solution of [^{14}C]glycine (6 $\mu\text{C}/\text{ml.}$) into the internal jugular vein at a known rate. After 6 or 10hr. each rat was anaesthetized with diethyl ether and samples of blood, liver and skeletal muscle were taken. The tissues were homogenized in 10% (w/v) trichloroacetic acid, after which the protein was centrifuged off and hydrolysed overnight in 6M-hydrochloric acid at 100°. The specific