Tending animals alone does not yield food enough for man and animals and civilization. The difficulty with tending animals is that they eat themselves out of food. Man followed them constantly to new pastures. There were problems finding food for the animals as well as for man, but eventually man learned to provide food for both. This is known as agriculture, a combination of plant and animal culture, and they are closely related in yielding surplus food for man. Historically, whenever some men were not required to produce food, societies evolved.

Why Man Eats Meat

From the dawn of our beginning we have been meat-eaters when we had a choice. Why is animal tissue prized by us as food? It is because animal flesh closely resembles our own. We should find the balance of the amounts and kinds of nutrients that we need in meat, rather than in plant foods. Animal tissues all through nature have much in common. We can make fewer nutritional mistakes eating fresh meat that we have slightly cooked, than choosing from 100 plants those nutrients we need.

Animal Foods

The head, body and limbs of animals are composed of bone, cartilage, muscle, fatty tissue, skin and nerve. Nearly half the weight of the body is muscle. We eat these body muscles, if they are not too tough. Muscle is about three-fourths water, one-fifth protein, and the remainder fat, carbohydrates, vitamins and minerals. There may be large amounts of fat associated around muscle tissues. Fat tends to accumulate just beneath the skin, around muscles and in the body cavities.

Muscles vary in thickness and length from animal to animal. They are covered and held together with a tough tissue. This is not digestible, and it contributes to the toughness of meat. The tenderness of a piece of meat is directly related to the amount of tough covering tissue the muscles have. Aging meat by storing the carcass in a cool room tenderizes the muscles. This occurs by the degradation of some of this tough tissue by the enzymes in the now dead flesh. Gelatin may be made by boiling this tough covering tissue in water. Cooking meat, then, tenderizes in addition to the sanitary considerations. Some of the toughness of flesh is reduced by cooking. The tougher the meat, the longer it is necessary to cook it in order to produce a tender product (Table 1.2).

HALL, R.L. 1975. GRAS—concept and application. Food Technol. *29*, No. 1, 48-53.

HOFFMAN, W.E. 1947. Insects as human food. Proc. Entomol. Soc. *42*, 233-237.

HOWE, P.E. 1950. Foods of animal origin. J. Am. Med. Assoc. *143*, 1337-1342.

IFT EXPERT PANEL AND CPI. 1973. Organic foods. Food Technol. *28*, No. 1, 71-74.

IFT EXPERT PANEL AND CPI. 1974A. Nutrition labeling. Food Technol. *28*, No. 7, 43-48.

IFT EXPERT PANEL AND CPI. 1974B. Shelf life of foods. Food Technol. *28*, No. 8, 45-48.

IFT EXPERT PANEL AND CPI. 1975. Naturally occurring toxicants in foods. Food Technol. *29*, No. 3, 67-72.

KAUFFMAN, F.L. 1974. How FDA uses HACCP. Food Technol. *28*, No. 9, 51, 84.

KRAMER, A. 1973. Storage retention of nutrients. Food Technol. *28*, No. 1, 50-60.

KRAMER, A., and FARQUHAR, J.W. 1976. Testing of time-temperature indicating and defrost devices. Food Technol. *30*, No. 2, 50-53, 56.

LACHANCE, P.A., RANADIVE, A.S., and MATAS, J. 1973. Effects of reheating convenience foods. Food Technol. *27*, No. 1, 36-38.

LIBBY, W.F. 1951. Radiocarbon dates. Science *114*, 291-296.

LIVINGSTON, G.E., ANG, C.Y.W., and CHANG, C.M. 1973. Effects of food service handling. Food Technol. *27*, No. 1, 28-34.

MACGILLIVRAY, J.H. 1956. Factors affecting the world's food supplies. World Crops *8*, 303-305.

MATCHES, J.R., and LISTON, J. 1968. Low temperature growth of Salmonella. J. Food Sci. *33*, No. 6, 641-645.

MIDDLEKAUF, R.D. 1976. 200 years of U.S. food laws: a gordian knot. Food Technol. *30*, No. 6, 48-54.

MITCHELL, H.H., and BLOCK, R.J. 1946. Some relationships between the amino acid contents of proteins and their nutritive values for the rat. J. Biol. Chem. *163*, 599-620.

MURPHY, E.W., PAGE, L., and WATT, B.K. 1970. Major mineral elements in Type A school lunches. J. Am. Dietet. Assoc. *57*, 239.

NATL. ACAD. SCI. 1970. Evaluating the Safety of Food Chemicals. Appendix: Guidelines for estimating toxicologically insignificant levels of chemicals in food. National Academy of Sciences, Washington, D.C.

NAS/NRC. 1970. Evaluating the Safety of Food Chemicals. Food Protection Committee, National Academy of Sciences—National Research Council, Washington, D.C.

NAS/NRC. 1972. GRAS Survey Report. Food Protection Committee, National Academy of Sciences—National Research Council, Washington, D.C.

NAS/NRC. 1973. Subcommittee on review of the GRAS list, Food Protection Committee. A comprehensive survey of industry on the use of food chemicals generally recognized as safe (GRAS). Natl. Tech. Inf. Serv. Rep. *PB-221-925* and *PB-221-939*.

NAS/NRC. 1973. Toxicants Occurring Naturally in Foods, 2nd Edition. Food Protection Committee, National Academy of Sciences—National Research Council, Washington, D.C.

18 of which are leavening agents and agents for the control of acidity and alkalinity. The rest of the 32 materials includes: flavorings (mustard, pepper, MSG); propellants; carbonating and protective gases (carbon dioxide and nitrogen); and nutrient supplements (calcium salts and sodium caseinate).

The nearly 1900 other direct additives account for only 0.8 kg per year per person. This amounts to an average of 0.015 oz per year per person additive, or less than 0.5 mg per year. According to Middlekauf (1974) 0.5 mg per year is approximately 1 ppb of the daily diet for each additive. He suggests this to be compared with the NAS/NRC Guidelines for Estimating Toxicologically Insignificant Levels of Chemicals in Food (NAS/NRC 1970). It states that certain substances which are structurally simple, readily handled through known metabolic pathways, and in closely related groups of substances with low toxicity, may be considered toxicologically insignificant at a level of 1.00 ppm or less in the human diet.

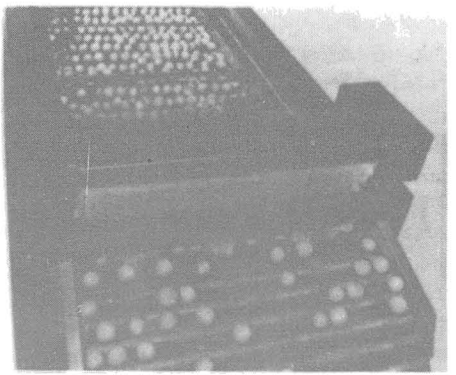
FEMA undertook a second nationwide survey of the food and flavor industry. Its survey revealed that of the 1249 substances on the FEMA list at the time of the survey, 831 were estimated to be used in total amounts not exceeding 450 kg annually. Moreover, the average maximum use levels in food were below 10 ppm in 228 of these substances. These criteria of total annual usage and minimal levels in foods, together with a safe history of use in food, are regarded by the FEMA expert panel as a basis for "toxicological insignificance" relative to flavorings and extracts, in the absence of any specific evidence or reasonable suspicion (based, for example, on chemical structure) to the contrary.

Filer (1976) summarizes the matter by indicating that reasonably good data is now available on the concentration of many additives contained in the foods we eat. Evaluation of consumer exposure to additives has proven to be difficult. The difficulties relate to: (1) the large number of food additives with potential for use in processed foods for which no use reports exist; (2) the multiplicity of processed foods including main dish meals and ethnic dishes; (3) uncertainties of losses or changes in additives during processing and storage; (4) complexities of dietary patterns including meals away from home and those of target populations such as the young, the aged and the poor and (5) uncertainties in portion size.

The Committee on GRAS Survey III believes even more reliable data on consumer intake of food additives will come from the expanded number of food categories, which will more accurately predict additive use in the future. Food additives are undergoing a close scrutiny. This evaluation will probably continue well into the 1980s. The food industry must continue to demonstrate its concern for the

Decay Control

Antimicrobial agents and senescence inhibitors can be used to delay the onset of spoilage in storage. Two methods of applying these agents are used: (1) a spray or dip in a solution or suspension in water/wax formulations and (2) fumigations. Treatments currently being used are summarized in Table 3.2. An example of the type of equipment used is shown in Fig. 3.4.



Courtesy of FMC Corp.

FIG. 3.4. APPLYING FUNGISIDE TO CITRUS FRUITS BEFORE STORAGE

Heat Evolved by Living Tissues

Freshly harvested fruits, vegetables, grains and beans are alive These living tissues respire and energy is released in the form of heat The amount of heat released varies with the commodity and increases as the temperature of the storage chamber increases (Table 3.3).

It is also becoming clear that the storage life of living matter, within limits, varies inversely with the rate of respiration. It was postulated and then found that reducing the rate of respiration could prolong storage life.

Temperature of Cold Storage Rooms

Temperature control in storage rooms is most important. Variations (Table 3.4) from desired conditions may be most damaging. These variations can be prevented if the storage rooms are sufficiently insulated, have adequate refrigeration equipment, and the spread between the temperature of the refrigerating coils and the temperature