

WORLD HEALTH
ORGANIZATION

ORGANISATION MONDIALE
DE LA SANTÉ

REGIONAL OFFICE FOR THE
EASTERN MEDITERRANEAN

BUREAU RÉGIONAL DE LA
MÉDITERRANÉE ORIENTALE

WHO/FAO SEMINAR ON FOOD HYGIENE, ZOOSES CONTROL
AND VETERINARY PUBLIC HEALTH PRACTICE

EM/SEM.VPH/3
5 September 1964

Lahore, 29 October - 6 November
Teheran, 7 - 11 November 1964

ORIGINAL: ENGLISH

MEAT-BORNE DISEASES

by

Professor Aage Jepsen
Food and Agriculture Organization Consultant*

* Royal Veterinary and Agricultural College, Copenhagen, Denmark

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I GENERAL CONSIDERATIONS

The title of this paper: "Meat-borne diseases" is a standing phrase in the terminology of WHO/FAO as well as of other organizations acting within the general sphere of public health and preventive medicine. By pointing out accumulated information on the role played by meat and meat products in the evolution of human disease, we expect to impress upon the public and administrations the necessity of maintaining adequate meat inspection and meat control services.

Many of those actively engaged in such services, however, cannot help feeling that this kind of approach is far from the mark. Meat inspection and meat control is not primarily a medical provision designed with the sole purpose of preventing meat-borne diseases. A list of meat-borne diseases may look impressive, but within the overall picture of the complexities of human diseases, meat is just one minor factor. I do not intend to minimize the importance of meat-borne as well as of food-borne diseases in general. It is just that meat, as well as other foods, are of such fundamental importance to human well-being that any food hygienist must feel himself responsible far beyond the primitive concept that food should not produce disease.

In order to correlate our thinking with the status and actual functions of food hygiene in practical life, we should revise our concept of food hygiene beyond the narrow line of preventive medicine. We should define our purpose to cover the wider field of protecting the world's food supplies against intrinsic and environmental factors which may cause losses, deterioration and harmful effects and thus endanger the well-being and safety of the people.

To the veterinary food hygienist this means that he should apply his knowledge of biology, animal science, pathology, epidemiology, microbiology, toxicology and biochemistry of foods to the safeguarding of foods of animal origin. From the extraction of the raw materials, all the way through manufacture, processing, storage and distribution, he should concern himself with protecting the hygienic quality of the food. The rapid advancement in food technology and industrialization of food production leaves the science of food hygiene and the practical

food control services with a heavy responsibility. It is our duty - before it is too late - to take care that this fair new world abide by the fundamental biological laws of hygiene. Food hygiene - including meat hygiene - therefore, must seek its contacts, not with medicine alone, but also with technical sciences. In fact, food hygiene is a bio-technical science itself rather than an associate of medicine.

As long as food hygiene and meat hygiene will continue to introduce itself just as a subsidiary of preventive medicine, we shall find it difficult to convince authorities, especially those in developing countries, that they ought to do something more about it. Faced with a mass of regular disease cases which obviously are in urgent need of attention, they do not find food hygiene an important contribution. They would, however, want to increase food supplies and improve the nutritional standards of the people. So if we adopt the broader scope of food hygiene as an activity which will support the food programme of the country by improving the hygienic standards of food production and food handling, we may meet with a better understanding. It seems quite obvious that efforts to increase food production and the total amount of food available, must go together with efforts to protect the hygienic quality of food. Otherwise, what is gained in quantity may well get lost in quality. The effects of faulty operations, contamination, spoilage, deterioration and increased risks of food-borne disease swallow up the benefits and hamper progress. This requires that food hygiene services do not confine themselves to legislative and judicial activities. They must adopt an active and progressive line of policy, designed for making an independent specialist contribution towards the improvement of operational standards within the food trade. By so doing, we shall change the scope of food control from a purely negative measure into a positive force, working for improved quality of foods and prevention of loss and waste. Food control will become a really useful tool with which the industry will find it profitable to maintain a cooperative relationship, instead of just fighting or tolerating it.

The establishment of a meat industry to replace the local marketing of fresh meat, presents a special challenge to meat control services. Fresh meat from the small local slaughter-house may well carry infectious agents, but immediate consumption following the traditional habit of cooking protects consumers to a very large extent. With centralized industrial production of processed, pre-cooked or ready-to-eat meat products for large scale distribution, post-slaughter contamination becomes a great risk, while at the same time the protective effect of thorough cooking, just before the meal is being served, decreases.

This should be well remembered when the impact of modern food technology changes the food habits of a population, that has learnt how to live in a certain environment exposed to certain given food risks - but is completely unaware of new such risks from new types of food on the market.

II MEAT QUALITY

Generally speaking, meat quality comprises all characteristics of meat and meat products which determine or influence the value, usefulness, wholesomeness and consumers' acceptability of the product.

Some of these characteristics influence solely the nutritional and gastronomical qualities by which the grading and quotation of meat are determined, for instance lean versus fat, tenderness, bloom, sex, age and race of the animal.

Others influence the hygienic quality. This term comprises every aspect of quality affecting the edibility of the meat, determining whether it is considered fit or unfit for human consumption: health risks, changes from disease, deterioration instead of freshness, appearance, taste or texture, contamination or admixture of some unappetizing or objectionable substance and reduced keeping quality. All of these are factors which in terms of hygienic status make meat unacceptable or less acceptable.

Ultimately, however, local standards of acceptability set by cultural traditions and general food habits of the population are of decisive importance, when it comes to the actual exercise of meat inspection rules.

When trying to analyze the problem in detail it may be practical to deal with the most important groups of quality characteristics separately.

1. Pathological conditions

Meat inspection at the point of slaughter as a practical undertaking is primarily a technique for rapid diagnosis of pathological conditions in the animals, by which to separate healthy carcasses from those affected by some diseased condition which may make the meat unfit for human consumption. When the meat inspector is to make his decision, he is not primarily concerned about meat-borne diseases, for the very good reason that the available means of examination in many cases do not permit the exact classification of the specific agent involved. As a matter of fact, whether or not such an agent is or could be noxious to humans, is not a decisive factor. The basic principles governing meat inspection rules of judgement do not distinguish transmissible from non-transmissible diseases. No matter what kind of disease, localized pathological lesions mean condemnation of the affected parts. Acute generalized lesions or acute systemic diseases mean condemnation of the carcass in total. Hence the meat inspector in the first place has to decide whether pathological findings indicate only local damage or reflect a generalized, systemic disease, which due to spread of infection, toxic or functional disturbances, affects the general state of health of the animal. This pathological and patho-physiological judgement - and not a specific search for transmissible diseases - is the only practicable and professional approach for the purpose of detecting and detaining such meat, which at the time of slaughter is defective in quality due to pathological conditions including transmissible diseases.

2. Bacteriological and biological characteristics

The microbiology of meat is closely related to conditions ante-mortem and post-mortem and consequently will be discussed under two headings, namely pre-slaughter (ante-mortem) infections and post-slaughter (post-mortem) contamination.

2.1 Pre-slaughter infections

In healthy animals under normal conditions, all tissues and cavities, which have no direct contact or connecting outlets to the external environments, are sterile or are at least only intermittently carrying micro-organisms in low numbers. Radical changes of this status result from bloodstream invasion of micro-organisms. Such occurrences, of course, are common in animals suffering from septic infectious diseases, but may also develop from accidental disturbance of the balanced state between the host organism and the micro-organisms, populating the natural germ-reservoirs of the host (skin, alimentary tract, parts of the uro-genital and respiratory systems). A good example is the regular invasion of micro-organisms from the skin-flora into the bloodstream, seen in animals slaughtered in emergency because of burns. Similar effects are seen when the intestinal mucosa is devitalized because of circulatory disorders, anoxemia or some local damage. Whenever animals are slaughtered in a condition of physical strain and physiological stress, whether due to extreme fatigue or disease, invasions into the bloodstream of micro-organisms from the intestinal flora may occur.

Pre-slaughter infections will change the normal state of internal sterility of meat and organs, and leave the carcass invaded by micro-organisms right from the point of slaughter. Such micro-organisms may include pathogens as well as a saprophytic flora. In the first case, meat-borne disease may arise, while invasion with microaerophilic and anaerobic saprophytes may result in rapid spoilage, developing from the interior, depth-spoilage.

Bacteriological methods of examination to supplement the organoleptic inspection of the animals are necessary, if one wants to detect and detain carcasses carrying ante-mortem infection. In many continental European countries such methods have a long history in meat inspection practices, and convincing experience has been gained from the vast material examined over the years.

2.2 Post-slaughter contamination

The slaughter operations, bleeding, skinning, evisceration and dressing necessarily result in an extensive surface contamination of meat and organs. Its origin primarily is the hides and the intestinal flora of the animals. Pathogens (especially salmonella and sometimes staphylococci from animal and human carriers) as well as a wide variety of saprophytes, are often encountered. In-plant contamination is highly important not only as a limiting factor for the storage life of the fresh meat and the various meat products manufactured from such meat, but also for the prevention of meat-borne diseases. Measures to control in-plant contamination, enforcement of hygienic methods of slaughter, segregation between unclean and clean operations etc., thus form an integrated part of meat inspection at the point of slaughter to be included with its functions. These functions, of course, must be extended to cover all subsequent handling of meat during transportation, storage, manufacture and marketing, because of the fundamental part played by microbiological processes at all stages. The microbiological characteristics of fresh meat, as well as of manufactured products of meat, when reaching the consumer, may be regarded as a resultant of the initial contamination acquired at the point of slaughter and bacterial growth, modified by the selective effect of physical and chemical means of preservation and additional contamination acquired at later stages. At any time, negligence in complying with the biological laws of microbiology may convert safe meat into dangerous meat or result in loss and waste from spoilage and inferior products.

3. Chemical and physical characteristics

Under this heading is listed a number of characteristics, which may become of considerable importance to meat quality, such as stability of fats, stability of colour, denaturation of proteins and certain enzymatic processes leading to undesirable decomposition ("bone taint"). Within the scope of this presentation, however, only the problem of chemical residues in meat will be touched upon, as this is a matter of increasing concern to public health authorities in many countries.

3.1 Insecticides

Residues of the numerous insecticides and pesticides used in agriculture to control weeds and plant disease - contrary to the common expectations - seem to reach man primarily by way of animal products such as milk and meat. This is due to the fact that most of the chemicals are not stable on vegetable crops, but decompose fairly rapidly when exposed in the fields to ordinary climatic conditions. Animals, fed such crops before natural inactivation of the chemical is complete, tend to accumulate the compounds and may work up considerable concentrations of the toxic compounds. This is especially true with the fat-soluble chlorinated insecticides (DDT, hexachlorocyclohexane, chlordane, toxaphene) which follow animal fats.

3.2 Antibiotics and chemotherapeutics

Residues of these compounds may originate from either therapeutic use or from feeding the animals medicated feedstuffs. Penicillin, tetracyclines and sulfanamides are among the compounds most commonly used. Residues are more readily demonstrable in kidney and liver tissues than in muscles. Danish Meat Inspection Regulations require testing of a kidney sample, if animals are slaughtered less than six days after having received the last therapeutic dose.

As for medicated feeds their use must be discontinued not less than six days prior to slaughter.

Testing of kidney tissue is performed by means of a simple plate diffusion test, a piece of tissue being placed on an agar surface inoculated with a sensitive strain of micro-organisms. After incubation, the plate is observed for zones of inhibition. This method has proved useful for detecting the fairly high concentrations of the bacteriostatic drugs, found in the kidney of animals within a few days after treatment. In order to detect the much lower levels present in tissues of animals after feeding low level medicated feedstuffs, special methods of extraction and concentration of extracts are necessary.

In our laboratory such methods have been developed. In chicken, fed six weeks with a feed mixture containing five units of penicillin per gram, 7 to 0.03 thousandths units of penicillin were demonstrated per gram kidney tissue up to six days off the penicillin-feed.

In chickens fed 10 mcg of terramycin, kidney tissue contained 0.09 to 0.017 mcg of terramycin per gram up to three days off terramycin-feed.

3.3 Oestrogenes

It should be mentioned also that the use of oestrogenes for promotion of growth, sexual neutralization or for therapeutic purposes in animals and birds for human consumption has been prohibited by law in a number of countries