PROCEEDINGS OF THE NUTRITION SOCIETY

A debate was held in the Morris Lecture Theatre, Robin Brook Centre, St Bartholomew's Hospital, West Smithfield, London on 21 May 1985 and formed part of the Four Hundred and Fourteenth Meeting of the Nutrition Society

DEBATE ON 'SALT, A RISK FACTOR IN HYPERTENSION'

INTRODUCTORY PAPERS

Salt technology and dietary intake

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We are all aware that the food industry, nutritionists and governments are criticized by the media because they have not persuaded the public to change its diet. The more extreme have claimed that if only their advice were followed, coronary heart disease and its cost, financially and in the human misery it causes, would disappear.

First let us remind ourselves that salt is an essential nutrient. It is essential for the proper functioning of the body, for example in the regulation of body water, the maintenance of osmotic pressure of body fluids, the permeability of cell membranes and the control of acid-base equilibrium. Salt is essential in another sense. It is a maxim of nutrition that good health calls for an adequate intake of all the nutrients. An adequate intake depends on meeting two criteria. The first is an availability all year round of a wide variety of foods, and the second is that these foods have to be palatable and enjoyable, otherwise consumers will not eat them. It is in the context of good nutrition—variety, availability and enjoyment—that the role of salt in foods is reviewed.

Salt in food production (Druce, 1983)

Salt has served a number of essential functions in food production, for example as a flavouring, preservative and texturizer, either by itself or in combination with other ingredients, for thousands of years.

Sodium is so important to our well-being, that we have the innate ability to recognize the taste of its most important compound, sodium chloride; common salt. When it interacts with the taste-cell membranes, an innervatory sensory nerve is excited, the salivary secretions increase and the oral stimulation initiates

digestive activity. In this way foods are made palatable, and the lack of adequate amounts of salt causes many foods to be flat, tasteless and unappetizing. The uses of salt to flavour foods are legion, for savoury foods, meats, vegetables, and dairy- and cereal-based products. As an example it has been reported more than once, that bread without salt is so insipid that it is unsaleable. In addition to its salty taste it acts to accentuate the flavour of other major and minor constituents. It is used to emphasize the sweetness of sugar and bring out the delicate bouquet of coffee.

The use of salt as an anti-spoilage agent is steeped in history. Heavily salted, dried and smoked meats were common in earlier times. Nowadays, using salt like this has been reduced because of various developments such as refrigeration, improved hygienic handling practices and packaging. Salt remains, however, as an important contributor in complex preservation systems in foods.

Preservation is effected by the regulation of water activity within a food, which retards or prevents the growth of spoilage and food-poisoning micro-organisms. Alteration of the environment in a food can be achieved by drying, heating, freezing or by the addition of a hydrophilic chemical. Salt is one of the most effective hydrophilic agents, either on its own or in combination with other processes. Thus brine is used to preserve vegetables such as cucumbers. In combination with drying, in semi-moist foods, it reduces the water activity below a level where most pathogenic micro-organisms cannot grow, but allows sufficient water in the product to maintain its palatability. In ham, bacon and cured-meat products, common salt plays a unique antibacterial role when used in conjunction with nitrite. Sodium nitrite or the nitric oxide it generates is the only single substance that selectively prevents the formation of botulism toxin. This effect, particularly in vacuum-packed products, is only possible in a concentration of about 40 g sodium chloride/l. There is also the preservative effect of salt obtained when the appropriate concentration extracts nutrients from the food and allows the correct progression and growth of lactic acid bacteria, which in turn suppress growth of spoilage and pathogenic micro-organisms through the acid produced. Blue cheeses, fermented sausages and meat products of all kinds, vegetables such as cabbage in sauerkraut, and olives and yeast-leavened bakery goods are typical products that depend on this process.

The use of salt in food manufacture is not confined to its flavouring and preservative characteristics. There are a number of other products where salt plays a specific technological or functional role. In comminuted, emulsion type meat products, salt extracts and solubilizes myofibrillar proteins. These form a matrix, which by coagulation in cooking, binds water, fat, lean meat and other ingredients resulting in products of acceptable yield, quality and overall identity. In bakery products, salt has a strengthening effect on gluten. In this way it improves the handling qualities of the dough and regulates its water absorption. In Cheddar-cheese production salt controls the development of bitter flavours by exercising an inhibitory effect on the proteolysis of β-casein.

Brief mention must also be made of the use of salt as a vehicle for prophylactic

medication. Severe iodine deficiency and iron-deficiency anaemia affect hundreds of millions of people around the world. Iodized table salt has been used for decades to control goitre (Anon., 1983) and other deficiency disorders in endemic areas, and Fe-fortified salt is being provided in India to control anaemia (Anon., 1984).

Reduction of salt in food

Are there alternative flavours? The more extensive use of spices and other flavourings is possible, but in so far as saltiness is necessary to avoid blandness and maintain product acceptance, overcoming the bitter flavour caused by potassium replacement still remains a major problem. And, as far as salt's other functional attributes are concerned, many of them are unique, and the present state of food science is not adequate to allow any general recommendations as to the performance of new products with or without other chloride salts. It is concluded that at present we have to depend upon the considerable contribution of salt to make available a vast spectrum of our food products necessary for a balanced diet (Sofos, 1983).

Dietary salt intake

Estimates for the national average salt intake vary between 10 and 12 g/d (Druce, 1983; National Advisory Committee on Nutrition Education, 1983) but they are probably high. The figure of 3–4 g, which is normally included for discretionary salt intake (Druce, 1983) in these totals, grossly overestimates the actual salt consumed. They are derived from sales information, and household salt is used for a wide variety of purposes in addition to being used at the table or as an adjunct in cooking and not necessarily ingested. It is more likely that an average figure of about 1–1·5 g is more realistic for the intake of discretionary salt and is borne out by some work done at the Food Research Institute, Norwich (Shepherd *et al.* 1984*a*). On this basis the average daily intake figure of 7–10 g salt given in the recent COMA report (Department of Health and Social Security, 1984) must be fairly accurate.

In the USA it is commonly believed that apart from discretionary salt, approximately 50% is derived from Na naturally present in food and the rest is in the form of added food ingredients. However, workers in the UK believe that most of the salt we eat comes from processed foods (Sanchez-Castillo *et al.* 1984; Shepherd *et al.* 1984*b*).

Just as much as estimates of salt intake vary, so do estimates of our needs. Whereas there is little doubt that the physiological requirement for survival ranges between the equivalent of 0·5 and 1 g salt, the National Academy of Sciences in the USA estimates a requirement of between 2·8 and 8·4 g/d (National Research Council, National Academy of Sciences, and Food and Nutrition Board, 1980). The average salt intakes in the UK are not very far removed from the upper figure, and it is difficult to understand the intensity of the exhortations that have been made to reduce salt in our diet.

The strategy of primary prevention of hypertension, through dietary manipulation, hinges on a fundamental premise that benefits accrue to a part of the population by the reduction of salt intake, and that it will not harm anybody. However, risks to health for those whose intake of salt is at too low a level have been reported (see, for example, Brown *et al.* 1984). To place this matter in context, indications of the variability from which the results of average salt intakes are derived have been reviewed. For salt derived from foods, naturally present and processed, the means and standard deviations of salt intake obtained from two small studies in the UK were 9·3 (2·8) g based on dietary recall (Druce, 1983) and 6·8 (2·0) g based on daily excretion results (Shepherd *et al.* 1984*a*). Although the application of these results to the whole population is not valid statistically they do indicate that about 20% might already be eating less than 5 or 6 g salt/d, a figure which is often quoted as a desirable intake. Are those individuals (1 in 5 or 1 in 6 of the population) already at risk now, and will more be put at risk to other disease as a consequence of further reduction in their total salt intake? If they are, then the general reduction of salt in the diet is fraught with danger to a considerable section of the population.

Effects on other nutrients

It is also of relevance to raise the question of the emerging importance of dietary calcium in hypertension, and there is not only discussion on the adequacy of the current Ca intake, but work in the USA points to a positive role of Na intake in maintaining adequate Ca metabolism (McCarron & Morris, 1984). There is also concern about the risk of Fe-deficiency diseases among young women (Barber *et al.* 1985) and Ca deficiency in adolescents (Hackett *et al.* 1984) in the UK.

The dependence of a wide variety of commonly eaten foods, especially meat, milk and cereal-based products, on salt as a flavouring, and on salt technology in order to supply us with the means of eating a balanced diet which is the basis of adequate nutrition, has been considered. It follows that manipulating the diet to restrict the intake of salt should not be allowed to bring in its wake other potential nutritional deficiencies to the detriment of our health.

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