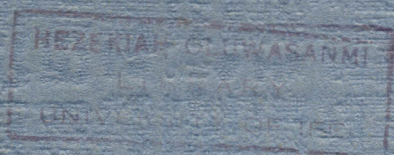


UNIVERSITY OF IFE · NIGERIA



Inaugural Lectures Series 1

**NOT BY
BREAD
ALONE**

by G. R. Howat

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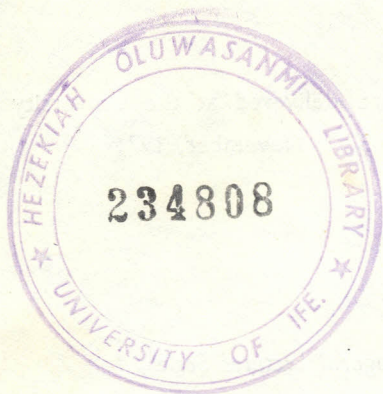
G. R. Howat
Professor of Food Science

An Inaugural Lecture delivered at the University of Ife,
on 30th November, 1971

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MORE than thirty years have passed since I first set foot in West Africa and about twenty-five years since I first visited Nigeria. Naturally over such a long period the country has changed greatly. One thinks of the fundamental political changes that have been brought about, of the educational developments including the establishment of universities, that have been such a factor in political change, and of the emergence of a large and influential intelligentsia. At a different social level one has seen too the development of the trade union movement and the associated rise in the standard of living of urban workers.

But to me one sociological change of fundamental importance has been what, for what of a better word I call the emancipation of women. Not that women have ever been an insignificant social factor in West Africa, or at least in most parts of it. They have worked, travelled, formed their own groups, and their voices have not been silent in matters affecting their children. What I refer to in their "emancipation" is that emergence of a generation of educated, articulate, and purposeful married women working outside their own homes in the professions, Civil Service, education, shops, offices and factories. In these spheres of human activity they hold positions which twenty-five years ago were almost exclusively held by men.

Naturally, the number of such women is still only a very small percentage—certainly less than one percent—of the total female population of Nigeria. But their influence and examples are very far-reaching and must be a significant factor in moulding the thinking of many girls now at school. Certainly no reasonable observer expects that this part of the social pattern is likely to be reversed in the near future.

To those of us who are involved in food matters and reaching out into the food industry, this sociological change is of fundamental importance. Whatever her position outside the home the woman, as wife and mother inside it, is still charged with the responsibility of feeding her family. One consequence of her new dual responsibility as working woman and food provider is that she must look for more convenient foods—and that means less traditional ones—than her mother or grandmother prepared. For example, a capable female personal secretary after a busy day in the office, typing letters, answering the telephone, and filing correspondence and handling all the other matters of an office will not take kindly to going home and pounding *fufu* for her family. (And if she lives in the top floor of a high-rise apartment block the landlord won't want her to do it either). The working mother wants something that her family will like to eat, something that she believes will be good for them. But above all it must be convenient to prepare.

The astonishing growth in the consumption of bread, for instance, in the past ten years is undoubtedly associated with its convenience both in urban and in rural conditions. Bread is in fact the prime example of the silent revolution in eating habits that is now in progress in Nigeria. You can buy bread—wrapped bread, too, which is a hygiene plus—over the whole of Nigeria. It is now a regular item of diet of the urban dweller whether in the North or in the sophisticated South. It is eaten by children, by lorry drivers, by nursing mothers, by labourers, by students, indeed the entire range of social classes.

Its convenience, its keeping ability ("shelf life" to the food technologist) and its relative cheapness have enabled it to become big business. The figures speak for themselves. In 1965, the value of the imports of wheat and wheat flour and similar products amounted to just over £3.5 million. By 1970, they had increased to £7,979,000, more than one hundred percent. No precise figures are available to indicate how much of this import goes into the baking of bread by professional bakers. One has to bear in mind that there is now a sizeable industry in biscuit production and that domestic and professional catering absorb a significant quantity. If we assume that the bread baking industry accounts for about eighty percent of the total wheat imports this means that for 1970, £6.4 million was used to import flour for bread-making. By any standard that is a lot of foreign currency for one item of food. It is indeed the largest single food import and on the evidence of the past ten years it is likely to become larger still. In such a situation it is inevitable that the minds of food technologists and of statesmen should turn towards import substitution programmes.

Bread-baking technology has advanced very rapidly in the past fifteen years in the U.S.A. and the U.K. It is right that Nigeria should also advance along this front.

But it is not only in wheat and flour that food imports into Nigeria are high. The figures for imported milk products are also high. In this lecture I am limiting milk products to evaporated milk (unsweetened), condensed milk (with sugar added) and whole milk powder. In 1965 the value of these commodities was £3.63 million but in 1970 the figure had increased to £6.84 million an increase of eighty-eight percent. Even when allowance is made for increased world prices during this period the level of increase is high. It is accepted that consumption of milk products generally increases with the standard of living so as the standard of living rises in Nigeria, the demand for these milk products will increase, especially in the urban areas where wage levels are higher than in the country. On nutritional grounds such as increase is to be warmly welcomed.

But the cost is high in terms of foreign exchange and a new development in milk products that is slowly gaining ground in Nigeria is therefore of significance. This development is the reconstitution in water of high quality imported separated (or skimmed) milk powder with butter oil into liquid milk. One of the largest American dairy firms is involved in this development. It is worthwhile spending a minute or two on what is involved. The background is relatively simple.

It is expensive and difficult to transport a perishable commodity like fresh milk into areas where it is not freely available. Therefore, for markets such as ours milk is almost always condensed, sometimes with sugar added, before it is tinned and sterilised. An even better method is to remove *all* the water from the milk usually by spray drying. The product so obtained—milk powder—is familiar to all members of this audience. When it is freshly prepared, using good milk and good processing techniques, the powder reconstitutes into water without difficulty to give a product with an acceptable flavour.

But milk powder has one serious disadvantage. It does not keep well. By the time it has reached the department stores in this country it frequently has an off-flavour which, when it becomes strong, is unpleasant to many people. Manufacturers have tried with only limited success to prevent this deterioration, including packing the product in vacuum or in an inert gas such as nitrogen. It is really the milk fat which is responsible for the off-flavour. It combines with oxygen to give oxidised products with a characteristic flavour. In contrast the deterioration in separated milk powder is much slower.

The development to which I refer is extremely simple. It comprises separating the cream from the milk, making the cream into butter, and finally removing all the water from the butter (usually about fifteen percent water is present in butter) to make dehydrated butter fat, sometimes called butteroil. This butteroil is very stable. It does not become rancid even after several months in storage. The separated milk arising in the preparation of the latter is spray-dried into separated milk powder. As we have already noted this product keeps well.

We therefore have two products—butteroil and separated milk powder—which keep well. So this development involves importing into Nigeria two separate products and reconstituting them in water to produce a "reconstituted milk" of acceptable quality and reasonably low cost. In a number of tropical countries including West Indies and Malaysia, large quantities of this reconstituted milk are available. There seems no reason why such a product should not become a regular feature of the diet here also, at least in the towns.

There is a modification of this process which has been developed and which could be of special interest to us. This modification consists in replacing the butteroil with a blend of vegetable fats. Such products are in fact already produced on a commercial scale. Products containing these vegetable fats are called "filled milks". Their manufacture presents some technological problems but these are not insurmountable.

The processing of meat and pork (especially pork) into canned products is a relatively new development in this country. Several firms are doing it and generally are doing it well. This development is to be welcomed on various grounds. One of these grounds is that it provides a possible answer, perhaps the best answer at present, to the problem of keeping meat—whether beef, mutton, pork, or poultry—edible over long periods.

To this audience it is not necessary to underscore the point that meat kept at ambient temperatures deteriorates very rapidly. It can sometimes be quite inedible after twelve hours. In even shorter periods there can, under some conditions, be sufficient development of bacteria to make its consumption a risk to health even when there is only limited flavour change. It is my view, although I have little formal data on which to base it, that a high proportion of the gastric upsets from which we all—Nigerians and expatriates—suffer are due to the consumption of meat which has been the subject of bacterial attack. It is commonly believed that if meat which is "off" is well cooked no hazard to health exists from its consumption. This is not necessarily so. Some types of bacteria can produce toxins which persist even in well-cooked meat and can cause severe digestive upsets.

In countries where there is a well-established meat industry extensive use is made of chilled storage. This means taking the temperature down to freezing point (0°C) or a few degrees below. Under such conditions, meat keeps well for several weeks, possibly as long as two months. Some fresh meat and some fresh fish are available in these conditions in the department stores in large towns. But such storage is expensive and limited in availability and cannot be considered a large source of meat or fish for the great mass of the population.

It is for this reason that I welcome the establishment of a meat canning industry in Nigeria. Ideally, in such an industry meat from the carcass would be processed with minimum delay into cooked sterile products inside sealed tins. As a second-best, carcass meat would be transported in a frozen condition from the abattoir to the processing plant for canning and cooking.

The quality of these canned products—stews, sausages or compounded meat products—depends on the quality of the fresh meat

used and on the standard of hygiene at the processing plant. From a limited survey of the products available it appears that the quality is adequate, particularly in the case of pork. The bacteriological condition of these products will inevitably reflect the state of hygiene maintained at the plant where they are manufactured. Canned meats generally have a good record of freedom from infection and if operating condition in the plants in Nigeria are satisfactory from a microbiological viewpoint the products available will also be good. The outstanding advantage of canned meat products in this country is that they make available a high grade protein food which keep edible for a period of months without special storage conditions and therefore can be widely distributed.

Like fresh meat these canned meat products have one serious disadvantage. They are expensive and quite out of the reach of a large part of the population. Most people will need to depend for a time yet for their animal protein on the flesh of a sheep or goat killed in the village or on the cow slaughtered behind someone's compound and offered for sale in the market.

The microbiological hazards in this practice are considerable. The fact that the local population has for generations been exposed to such hazards and in some cases individuals have built up some resistance to infection should not blind us to the fact that sickness, sometimes serious sickness, arises from the consumption of contaminated meats. A worthwhile contribution to the general health of the country would be made if these conditions of fresh meat handling could be avoided.

There is one area of development in the food industry of which many Nigerians are unaware but which is of growing significance to the economy of the country. This is the partial processing of oilseeds before export. At present three crops are involved, groundnuts, palm kernels, and cocoa beans.

Before World War II there was virtually no export of groundnut oil from Nigeria. The whole crop, apart from that used for domestic consumption, was exported without any processing. During that war, and under the economic stresses that arose in it, some extraction of oil began to take place. After the war, this extraction continued and expanded and a sizeable oil-crushing industry developed. By 1965, 100,000 tons per annum were exported. A comparable situation existed in relation to palm kernels. These too used to be exported to Europe for crushing and extraction of the palm kernel oil. Now the figure for exports of oil amounts to many thousand tons per annum.

After hardening, palm kernel oil is the basis of many cookery fats available in the domestic and industrial markets. So far no hardening

plant is in operation in Nigeria. One can only hope that such a development will take place in the near future.

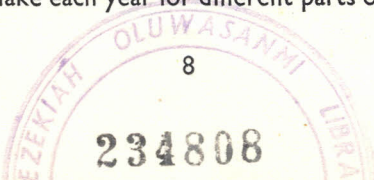
The case of cocoa beans is of special interest. For many years it was considered by the cocoa and chocolate industry in the consuming countries that it would be impracticable to undertake processing of beans in the country of origin. The beans after fermentation and drying were therefore exported to the U.K., the U.S.A., and continental Europe for processing. Stimulated, I believe, by experiments in Ghana, the Marketing Board in this country set up a plant near Lagos where beans were roasted and had the shell removed in a winnowing process. The kernels or "nibs" were then ground to a very fine paste to give a product known as "cocoa liquor" or "cocoa mass". This is an important intermediate material in chocolate manufacture and many tons are now exported annually. In addition, some of this liquor is pressed in special equipment to produce cocoa butter (with cocoa press cake as by-product). This too is an essential ingredient in chocolate manufacture. It has also wide application in the cosmetics industry.

So far in this lecture I have gone into detail about a few of the bigger changes in the food industry over the past fifteen to twenty years. One should consider these however only as examples of wide areas of innovation. Other important fields are being opened up. For example about one-third of the total granulated sugar consumed in this country is now produced here. This is a large quantity and should be seen against a growing demand for sugar as living standards rise. In addition there are tinned soups, biscuits, cooking fats, sugar confectionery, instant coffee, fruit juices, jams, soft drinks, ice-cream, and beer.

The total volumes of sales, except for beer and soft drinks, is quite small in relation to Nigeria's total population but the probable pattern for the future is already clear.

Those of you with an eye, or one should say, an ear for omissions will have noted that no mention has yet been made of the fishing industry. This omission is deliberate and arises because even approximate figures for the amounts of fish caught in the sea, rivers, and lakes are not available. Such figures as are available for one or two areas suggest that fish consumption is by far the greatest source of non-vegetable protein for the whole country. For instance, deep sea fisheries off the coast have produced in the past few years more than 20,000 tons of fish annually. This does not include the catch from sea-going canoes powered with outboard motors or that of the fishermen in the creeks.

Lake Chad makes also a significant contribution and a quantity of around 20,000 tons of "banda", i.e. partially dried and smoked fish, leaves the lake each year for different parts of Nigeria. I believe



it is possible to buy in Lagos smoked fish caught in Lake Chad. One could not easily have a longer distribution chain than that! Similarly the Kainji Dam is the source of much smoked fish, probably 3,000 or 4,000 tons per annum. This also travels long distances before it is sold, in some cases going as far as the East Central States.

There appears to be virtually no figures available for how much comes from the rivers. That the amount is large is certain. Just how large is still quite unknown. Much detailed work in this area of food production is called for. One might also add that the smoked fish currently available has a very short keeping life and some of it reaches the consumer in an infested condition. I do not see the current quality standards being acceptable to the market for many more years. My own view is that for Nigeria the acceptance standards are much too low.

It is against this background of a new, diverse, and in some ways exciting, field that the university has decided to set up a department of Food Science and Technology. Both the "Science" and the "Technology" are important. Food science is concerned with the nature, composition, and properties of raw food materials and finished goods—what they comprise in terms of chemical and biochemical substances, how they can be analysed, what micro-biological status they have, and how they behave under specified conditions. Food technology is the application of this knowledge to new or traditional methods of processing and preserving foods.

One visitor who came to this University in 1969 to consider the development of a food department in it said in his report:

"Agricultural scientists and engineers, and veterinarians carry the responsibility that foods are produced economically and with the quality characteristics demanded by consumers and processors. Food technologists are responsible that the crop harvested, the egg laid, the fish caught and the animal slaughtered reached the consumer or processor with the minimum loss of substance, quality and nutrients".

He was not at the time discussing specific food problems in Nigeria but his words are relevant to this country.

There are as far as I am aware, only two university departments in the whole of tropical Africa which are classed as Departments of Food Science. One of these is at Legon, Ghana, the other is here at Ife. Teaching of Food Science is of course done elsewhere. For example at the University of Ibadan, there is a Department of Nutrition and Food Science. There is little doubt that both in this country and other parts of tropical Africa other departments specially oriented to food science and technology will soon be established.

It is right that this should be done. But for various good and practical reasons including the employment of students who graduate

in the subject, the timing of the birth of these departments might well be the subject of discussion at national level.

The three main tasks of a Department of Food Science and Technology are to generate new knowledge about the materials it handles, to initiate research into food problems, and to train students to take a responsible part in the nation's food industry and in those other sectors of the economy where they can usefully serve. In an international gathering such as this there may well be differences of opinion as to which of these aims comes first. There will be very little difference on their nature.

It would not be appropriate in a lecture such as this to go into detail of how the new department proposes to set about its business but some things can and should be said about the philosophy of technological education and the nature of technological research.

There is at present considerable criticism in Nigeria about the contribution which graduate technologists and engineers are making when they enter technical industry. In my contacts with the food industry I have met this criticism made equally strongly by Nigerian and expatriate managers.

It must be remembered of course that this kind of criticism is not limited to Nigeria. I have heard similar criticism being made in the United Kingdom about the contribution of young graduates in industry. To be fair as far as the U.K. is concerned, this criticism is much less common now than it was, say, twenty years ago. But it is still made.

An objective study of the position in Nigeria would, I feel, reveal two things. First, that industry expects too much too soon from the new graduates it employs. It is not without relevance to note that those U.K. companies which employ large numbers of graduates put them through a carefully thought-out program of training for one or two years before giving them positions of responsibility. In effect the need for training is clearly recognised. Second, that the universities may not in the past have made it as clear as they might to graduate technologists and engineers that they must learn the hard way how plants and processes operate before they can make a worthwhile contribution to the organisations which employ them.

When a student leaves this university after completing a degree course in food science and technology he is not qualified to run a food processing plant. If he elects to go into industry either in the private sector or in a state-owned organisation he will quickly make the sobering discovery that there are ordinary workers on the plant who know more, sometimes much more, about it and the products it makes than he does.

There is nothing amiss in such a situation, neither in the training the man has received nor in his ability to profit from it. It is a situ-

ation which can be resolved by the technologist settling down for a few months to learn *in detail* about the processes and products he is concerned with.

I remember very clearly my first contact with the food industry. I had graduated from the University of Glasgow and was awarded a scholarship by the Agricultural Research Council to investigate the heat-denaturation of the proteins of milk. My research director—who became later Sir Norman Uright of F.A.O. fame—wisely sent me to a large milk processing plant to get some background to my problem. I can still sense my surprise that a group of men, none of whom had any advanced technological training and certainly nothing comparable to my First Class Honours B.Sc., could so competently run that large and complex plant to produce milk powder of constant quality. I just could not understand it.

In due course I, too, learned to run such plants and at the same time discovered how useful my scientific training and background was, and the contribution which it enabled me to make.

If the young men, and in due course the young women, whom we send out to serve Nigeria's food industry are to justify the money spent on their education and on the salaries they expect to be paid they must learn that lesson too. It is our task to ensure that they realise that there is a lesson to be learned.

Technological research is a subject which calls for some comment. Technology is essentially applied science; one dictionary calls it "the science of industrial arts", that is, it deals with the application of scientific knowledge to industrial problems. It is to be expected, therefore, that research undertaken in technological departments will be research applied to specific and known industrial problems. It is therefore to be clearly distinguished from pure scientific research which aims at the solution of problems for their own sake.

Technological research, therefore, operates with different criteria of acceptability. For instance, the problems dealt with are often those which need to be solved rather than those which individual workers would like to involve themselves with. Furthermore, the degree of success in solving the problem is more often clearly apparent than in other research areas.

It must be remembered that all industrial organisations attempt to solve research problems although they may be described as "trouble-shooting". For example, a manufacturer who is producing a carbonated soft drink may find that some bottles of his product quickly develop growth of mould in the product. He will attempt to prevent the development of this growth by making changes in the ingredients he uses or in his processing techniques; or by improving his hygiene standards. He will, in due course, find a solution to his problem.

True industrial research is of course more advanced than this and has often clearly stated objectives and precise definition. But any research costs money and technological research costs a lot of money. So the difficulty about research carried out by industrial firms is that the research is often halted when the immediate problem in hand has been solved. This is true even when the researchers are still seeing other areas of interest of possible value to the company.

In technological research organised from a university, the objectives are normally wider than those laid down in industry. Nevertheless, the researchers set out generally to solve specific problems.

In a country such as Nigeria today with its considerable pace of industrial development, it is evident that technological research must find a considerable place. This is as true in the food industry as in any other area of development.

The kind of problems which the new department in this university will tackle will be those which have an immediate application to the economy of Nigeria. We want to ensure that the country is better fed than it ever has been, that less food is wasted by unsatisfactory storage, that imported foods are used only when local foods are not available and to ensure that the processes used by food manufacturers avoid the addition of harmful or unnecessary substances. These are wide reaching aims but the wise researcher will always give himself wide horizons within which to operate.

Perhaps one of the greatest dangers facing the technologists when doing research is that he begins to feel that research is valuable only when it is applied to some precise and specific problems. When I feel this way—and I admit I sometimes do—I remind myself that some of the great developments in science arose by chance. They tell a story in one of the large universities in the north of England about how the modern dyestuffs industry came into being. The story runs somewhat as follows. A young research student in chemistry was working on a certain branch of organic chemistry which used to be called azo-compounds though they may well have a different name today. He was stirring the contents of a beaker with a thermometer when he struck the side of the beaker with it and the thermometer broke spilling some of mercury into liquid. It was near the time of his mid-day break so being a young man who put first things first he decided to go off for his lunch and start to repeat the experiment on his return. When he returned 45 minutes later, he found the whole content of his beaker a beautiful purple colour. What had happened was that the mercury from the broken thermometer had catalysed a reaction which produced the coloured compound. Out of this simple accident came a great part of the modern dyestuffs industry.

I hope our research students in due course will not break too many thermometers but the incident will, I hope, remind us that pure research has an abiding place even in our Faculty of Technology.

There is another field of interest with which the department will, I hope, become involved. This is the field of food standards. To the best of my knowledge there is no legislation in this country at present governing any aspect of food composition, food hygiene, or food labelling. In a country which has, as we have seen, a rapidly growing food industry this must be described as unfortunate. Draft legislation has been prepared but has not yet been enacted.

There is a perfectly understandable reason for this situation. It is the lack of enforcement facilities coupled with limited facilities for food analysis. The Federal Ministry of Health operating through the Federal Government Chemist's Department has however instituted a food survey covering many items of food manufactured in Nigeria. From this survey it should be possible to establish standards for different manufactured foods which will protect the consumer and give reasonable scope to the manufacturer. The next logical step would be to set up some form of enforcement agencies.

It must not be thought that I am suggesting that the majority of food manufacturers will take advantage of the present situation to mislead the public on the nature of their products. On the contrary, I believe that most manufacturers will try to supply the public with the goods they want at a price they can afford. That policy, after all, is sound economics. Nevertheless, since food processing has become a highly organised and competitive industry it is right that some measure of public control should be maintained over what is sold and how it is described.

In the U.K., in Continental Europe, and in North America university departments teaching food science have played a part in the formulation of food legislation. They have the knowledge and background to do this. It would be right and proper for similar participation by the universities to take place in this country.

In conclusion Sir, I offer to you my thanks for the opportunity of delivering this lecture. If it has served to draw attention to the nature and extent of the food industry in this country and how this university can play a worthy part in it, then the labours of preparation have been amply rewarded.

