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Trends and Integration in Food Processing

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This article seeks to describe an operational model to examine food and food-related activities from a multiplicity of perspectives within an overall plan. The basis for this model contains the cardinal points of classic management theory as first proposed by Henry Fayol at the turn of the century, which are given as objectives, planning, organization, co-ordination and control.

The Food Cycle

The food cycle in context can be defined as being the total of a number of organized decision-making activities which ensure that all the productive resources of the food industry are put to their optimum use.

These resources include capital (money invested, land) machinery (technology), manpower, materials (required for growth or conversion) and the methods (adopted for maximum output or productivity).

One would think that the food cycle should logically begin with food production, but in a market economy the starting point of the cycle is the consumer, his needs, drives and demands.

The Consumer and the Market

Theodore Levitt, a doyen of marketing theory, in his classic article "Marketing Myopia", suggests that companies take too narrow a view of their market because they think in terms of their product offering, rather than in terms of the fundamental needs which these products satisfy. In his proposition he cites the example of the failure of the great names of Hollywood: "The film producers failed, because they failed to realise that they were not in the film business, but in the entertainment business".

He continues: "The American railroads thought of themselves as the ultimate development in overland transportation, and failed to respond to the invention of the internal combustion engine which gave us the car, the lorry and aeroplane. If the management of the railroad had thought themselves as being in the 'transport business' then doubtless they would have integrated these new methods of moving goods and people into their existing network".

Understanding Consumer Needs

Patterns of food acceptance in humans are in the main acquired, and once they become established within society, they become part of the culture and social fabric of that society and are very resistant to change.

In the eighteenth century Anthelme Brillant-Savarin stated "Tell me what you eat and I will tell you who you are". What man eats is apparently very simple, what is often more difficult (from the outside) is to explain why many foods which are nourishing and available are not fully exploited. Meat, for example, is not acceptable to a vast number of groups, and the same applies to fish, particularly molluscs and crustaceans.

It is through establishing the basic reason for these acceptances and rejections that we can lay the foundation for understanding the wider aspects of consumer choice.

Food Choice Determinants

There are two distinct levels of analysis to consider in attempting to draw a profile of consumer needs in food terms. In the first level of analysis, that is, on a macro scale important for the food export market, three main factors form the primary determinants of food choice:

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(1) The environment which influences the development of cultural practices (Determinism).

(2) Cultural practices which establish societal norms, attitudes, beliefs, and in context, patterns of food acceptance and rejection.

(3) Man's position in society, which is often reflected with the allocation of special foods of symbolic value.

The second operates within this parameter, but reflects acceptable levels of change within the set boundaries of social evolution.

The Environment

We must recognize that different environments make different demands on our physiological system. Man as an organism is dependent on his intrinsic ability to adapt to the prevailing environmental conditions to which he is exposed, as suggested by the Darwinian theory of the survival of the fittest, and clearly observable in the physical characteristics of the inhabitants of the two extremes, that is in the Equatorial belt and the Tundra region.

Many Easterners reject milk as a white blood

This adaptation factor is also clearly pronounced in the dietary practices adopted by the inhabitants of these regions, with the former living on a diet of fruits and vegetables, that resupplies any depletion of salts and minerals caused by perspiration while it prevents a rise in metabolic rate so as to retain maximum body fluid, and the second living on an almost entirely animal fat diet (seal blubber, whale and caribou meat) without vegetables and a minimum amount of deciduous fruits at a certain time of the year.

Culture

The cultural factor possesses an equally powerful influence in setting the parameters of food choice. For example, we are aware that blood in the Old Testament is a forbidden food and it is rejected in the Jewish and Islamic faiths. Likewise many Easterners reject milk as a white blood, and they also appear to have lost over the years the capacity for lactose digestion, and in consequence they derive no nutritional benefit from this common product.

Culture in turn has also been influential in determining various cuisine combinations with different flavour bases which contain within themselves many examples of nutritional wisdom, such as onions and meat, olive oil and lemon, pork and apple sauce, beans or corn with paprika, all of which have a pronounced beneficial effect on the diet, but which are also taken as the culinary expression of the region.

The food choice of various groups also reflects the effect of climatic conditions, such as the marked Southern European preference for a soup to open a meal, which contributes to the replenishment of the salt and liquid lost during perspiration, while Northern Europeans demonstrate a marked preference for fruit and fruit juices which supply the vitamins required by their diet, which does not make provision for an ingestion of fruits in regular form between meals, as the Southern European diet does.

Socio-economic Status or Purchasing Power

From ancient times all societies have used food to signify relative socio-economic status. Those with high status were assigned special foods which possessed symbolic value, and those with lower status had to survive on more utilitarian products.

Western society is changing rapidly, for a variety of reasons, such as:

(1) the impact of new technology on patterns of employment;

(2) the speed of travel;

(3) social attitudes and structures exemplified by the number of women at work and single parent families;

(4) variation in economic factors such as the cost of oil, or the need for increased contributions to support an increasing number of pensioners;

(5) increased leisure time and higher expectations from social living;

(6) faster pace of life and the value placed on time.

All of these factors have altered the form and type of food purchased.

Health Concern

Health concern results from a number of "wealth diseases" promoted by the changes in patterns of occupation, additional leisure time, smoking and richer food.

Throughout Western Europe concern with malnutrition in the form of excessive food intake and the wrong type of food has given rise to a number of initiatives which increase consumer awareness in a number of ways. In the United Kingdom two reports, NACNE (1983) and COMA (1984 and 1991), have been influential in altering long-established patterns of food choice.

Table I. *Allocation of Money to Food and Drink*

	Percentage of family income
Food and drink purchases in the UK	
1951	37.4
1961	30.4
1971	27
1981	21.8
1989	18.3
Food purchases in Italy	
1959	57.7
1966	45
1972	37.6
1985	28.9
1989	19.7

The UK has seen a considerable adaptation to the patterns of food consumption in the last 40 years. One of the reasons for this is that the amount of money allocated to the food and drink budget demonstrates a considerable amount of fluctuation (see Table I).

While major changes in the quality of food and the degree of convenience food purchased appeared firmly established by the late 1950s in the UK it was not until the early 1980s that the same phenomenon could be observed in Italy, when the food budget became less than one-third of the total family income.

With increased wealth there is a tendency to respond more positively to advertising and imitate the habits of the opinion leaders in food and drink practices. This is particularly noticeable in the case of wine consumption.

Wine in Italy and France was never regarded as an intoxicating liquor but as a useful adjunct to what was often primarily a mundane diet. At the same time it has always been a cheap commodity in these wine-producing countries, and consequently it suffered the stigma of being the drink of the poor, with the result that the younger generation is rejecting this traditional drink in favour of what they perceive as being purer and more sophisticated drinks such as: beer, Coca Cola, Orangina, Seven Up, and foreign spirits such as whisky (see Table II).

Although the export market has improved, the changes are minimal in terms of the productive capacity, which suggests that the amount of land previously allocated to wine production needs to be put to alternative uses. But the consumption of mineral water over the same period increased nearly ten-fold, reaching an average of 250 bottles per year per head in France, according to a recent statement.

Table II. *Patterns of Wine Consumption in Italy and France in the Last 20 Years*

	Litres per head of population by year		
	1971	1981	1991
Italy	102.25	73.25	61.20
France	105.55	83.25	69.79

These observations can assist in determining the production objective.

Setting Objectives

The Products? Which products and in what quantities? How shall the commodities be produced?

Changes in the nature and method of production are expensive and cannot be adapted at the last moment without considerable financial loss. Consequently product lines must be carefully evaluated, and fully tested.

Equally the principal quality characteristics of the product must be determined at this stage. That is as a single product, a modified product or an adjunct to a combined product.

For example, the production of oranges must be considered in terms of how the product is going to be sold:

- in its fresh state, which requires specific visual appeal; or
- as a fresh orange juice – in which case the freshness and sweetness of the product become the predominant factor; or
- for making marmalade, where the nature of the orange skin is important; or
- as part of a fruit salad, or as a combination of the last three.

Therefore the prime considerations are:

- assessing and forecasting the demand for the product at given price ranges which will determine the optimal level of production, and cut-off points which will indicate when the production becomes uneconomic;
- product development in its final format;
- studies which will provide an indication of the possible extent of demand as a substitute for an established

product. For example, the present market share of margarine as a healthy butter substitute;

- service to be provided in terms of distribution and continuity of supply.

Changing Patterns of Product Demand

In Western economies, occupational patterns, i.e. husband and wife both working, old people living alone, others working or studying away from home, result in a considerable proportion of meals being consumed away from home, which approximates at present 20 per cent of the number of meals consumed in the UK and almost 44 per cent of the number of meals consumed in the United States.

This pattern of consuming a considerable number of meals away from the familiar surroundings creates a predisposition for the consumer to purchase not only convenience food, but also a considerable amount of complete meals in a ready form. This pattern has become well established in the UK and a number of Northern European countries and is gradually becoming a feature of most EC countries.

Supermarkets possess persuasive power over consumer choice

It is for this reason that more and more space in the supermarkets is given over to pre-prepared products, which can be consumed in a ready form or need only to be heated by the purchaser. Additionally, in countries like the UK, multi-unit operators such as supermarket chains with more than ten units account for 90 per cent of the food products sold in the market. Thus the supermarkets not only possess persuasive power over consumer choice but also wield considerable power over the suppliers of the product. Health concern in the last ten years has had a marked effect on the reduction of canned food; however, the switch has been to pre-prepared meals which in many city centres account for nearly 15 per cent of total sales.

The advantage for the retailers in supporting this kind of development is obvious: the profit gained from sales is relative to the value of the product and not to the basic costs of the raw material. For this reason I believe that this trend will keep apace with relative increases in disposable income and improved technology for food heating in the home such as the microwave.

Planning the Product Lines

In thinking about products there are a number of relevant aspects to consider, but the four most important ones are: consumer needs, safety, quality and profit. These four aspects must be considered as an integrated whole rather than in separate compartments.

Some Theoretical Considerations

Identification of consumer needs: a consumer profile will assist in generating the kind of ideas that will permit a food product to be successful in relation to consumer needs. In general we must consider:

- The individual's age, religion, socio-economic status, ethnic origin, spending power, education, family composition, expectations.
- The purpose of the choice: pleasure or necessity.
- Time pressures.
- Whether the product is for the customer's own use or for trade.

Specific attributes of the product: the nature of the product must meet market requirements.

Organoleptic aspects of the product: organoleptic perception is the registration of a sense on a preceptor, which allows a person's sensory perception to appreciate the quality of the product in terms of his personal evaluation.

This evaluation is carried out by the five senses:

(1) The visual sense which predisposes the individual's other senses to the acceptance or rejection of the product. Colours, shape and recognition are important.

(2) The taste of food, which is limited to four main tastes: bitter, sweet, saline and acid, which combine in a variety of forms to produce different flavour sensations. Temperature incidentally affects the taste sensation.

(3) The sense of smell, which aids recognition and classification of the variety of foods and has a strong influence on acceptance or rejection of foods, as well as enhancing pleasurable anticipations that result in a flow of saliva to aid digestion.

(4) The sense of touch, which is concerned with tactile sensations, but in terms of food the mouth acts with the tongue to make decisions on the viscosity, texture, moisture and temperature of the product.

(5) The auditory sense is not given much importance in terms of food appreciation, but in many items the crispness and crackling of the product contribute to the customer's enjoyment.

Suppose that the product line that we intend to develop in the range of ready meals consists of a composite product

containing a number of ingredients, such as meat and vegetables, for easy preparation.

The product itself, once market research has confirmed its acceptance, will have to be composed on the basis of the organoleptic principles and then converted for a production line.

To this end we have to select a specific method of processing the food that will meet the consumer expectation of satisfaction.

Food quality control comes at the end of the productive cycle

At present, within the area of ready meals, the choice rests with three methods. Each of these methods offers specific advantages and disadvantages that need to be evaluated in order to arrive at the appropriate choice.

(1) Cook freeze

(2) Cook chill

(3) *Sous vide* or cooked in a vacuum.

The three methods of food production must be accurately monitored.

Monitoring the Systems

It is important to realize that in the conventional method of food processing/transformation, the food is cooked and served immediately or within a brief period of holding. During cooking the food goes through the critical temperature for maximum pathogenic growth from 16°C to 55°C once. But with each of these three systems the food is taken through this critical zone of optimum pathogenic growth at three different stages: therefore the adoption of these methods must be supported by appropriate monitoring procedures.

Quality Assurance

Quality can be defined as the total of the features and characteristics of the product or service that meet the stated or implied needs. In certain products it may consist of materials quality, performance or reliability. But in essence it consists of the product meeting the consumer/user expectation of satisfaction.

Within this definition concepts of fitness of purpose, customer satisfaction, safety and value for money can be included.

The British Standard 5750 attempts to set out how an organization can establish, document, and maintain an effective quality system which demonstrates a commitment to quality and the ability to meet the client's quality needs. This approach has been accepted in its entirety by the International Standards Organisation in its ISO 9000.

What it is important to realize is that food quality control comes at the end of the productive cycle, in essence is a reactive approach. Total Quality Management is a proactive approach which aims to lay down the practices and procedures that should prevent things going wrong in the first instance.

The Implementation of Total Quality Management

The approach which is adopted by each independent company depends on how the organization perceives its own role, but in essence there are three essential components:

(1) The specification (what is to be achieved).

(2) Documented instructions (how it is going to be achieved).

(3) The recording system (evidence on how the stated programme/operation has been achieved).

In relation to our example of pre-prepared ready meals the following needs to be established:

(1) *The product in relation to the consumer expectation of satisfaction.* As indicated, the product must meet the criteria of physiological and psychological requirements, that is, nutrition and safety and purchasing power. Storage of the meat product from the moment of slaughter to delivery may also be specified. For example, even during transport its temperature must be kept at 2°C. There are also a number of economic considerations to be established at this stage, e.g. what is the minimum viable number of products that can be produced in relation to the utilization of the productive resources? Poor budgeting may compromise quality.

(2) *A specification of the product.* Combination of ingredients and the quality of raw ingredients required. Because the systems that we intend to use must ideally use products which are bacteriologically safe, precise specifications must be laid down for their quality characteristics at the point of delivery. Thus it may not be sufficient to state the type or breed, age and sex of the animals, but also, given some recent food scares in the UK, the very nature of feed stuff used. Additional information on the generally accepted classification of grades and cuts may also be included. It is obvious that this is a difficult area for standardization, since various products may have to cope with different methods of cultivation and rearing due to climatic conditions. However, acceptable and unacceptable standards must be laid down.

(3) *The creation or adaptation of the physical productive environment that would secure approval*

of the laid down safety policies for production. It is important at this stage to ensure that the processing equipment possesses the quality features that would permit the product to be produced according to precise specification standards.

(4) *Production processes and methods.* The conversion of ingredients into finished products must be accurately specified in advance in a written form, so that the process adopted for the creation of the items in their final format results not only in a quality and safe product, but also in the customer receiving the same consistent product. In this section not only the preparation of ingredients is specified, but also the application of heat and energy to the product in its desired state, so that certain organioleptic characteristics such as colour, texture and flavour form an integral part of the product quality.

(5) *Storage.* The methods of packaging, preservation, storage temperature, and stock rotation need to be clearly specified.

(6) *Specification of control procedures.* The control procedures for organoleptic quality and microbiological safety need to be formulated and implemented, with specific instructions for management intervention.

(7) *Stock rotation and distribution.* A precise method for stock rotation, safety warning for slow moving items, and specific instructions for a distribution system must also be specified, including temperature maintenance during transportation.

(8) *Instructions to end-users.* A manual of instructions must be compiled for the end-users of the product which ensures that all the items are treated in the specific manner that leads to their optimization.

(9) *Staff training.* Staff training is another important aspect of advanced food production systems. The staff must become fully conversant with the expectation of quality and equally aware of the dangers associated with the effect of food poisoning bacteria. In normal cooking practices the internal temperature of food can be accepted at a level that retains an amount of pinkness, but in food prepared for long-term storage one must ensure that the centre of each item reaches a minimal temperature of 75°C in order to destroy any thermophyllic bacteria.

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