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Food Flavours Technology Handbook

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No doubt flavour is one of the most important attributes of the food products we eat in our daily life. Man does not eat simply to live but even more so lives to eat. Flavourings are focused on altering or enhancing the flavours of natural food product or creating flavour for food products that do not have the desired flavours for example bakery goods and other snacks. Flavour is generally defined in terms of three components; odour, taste and texture. Its characterization is concern with the similarities in human flavour perception using methods that designed to average out the differences. The flavour of foods may be classified as natural flavour (pre existing in diet particularly in fruits, vegetables and spices), process flavour (arising in end products as a result of conventional processes), compounded flavour (intentionally added flavouring), taste modifiers and abnormal taste and taints. Some of the flavouring materials produced by processing are chocolate, cheese, blue cheese, yogurt, wine, aroma chemicals etc. The flavour industry has become a vital element in the growth and success of food and beverage industries worldwide. The flavours industry remains very country specific and complex, with product formulations and flavours varying from country to country, as well as from region to region within countries. Processed foods, their flavours and textures, are adapted to local consumer preferences. Local or traditional foods have unique flavours evolving from the indigenous climate, land, etc. Generally speaking, trends in flavours closely mirror those in the packaged food and drink market. This includes the trends toward premium quality, savoury, natural and authentic, and health and wellness. The global flavour industry can be characterized as highly technical, specialized, and innovative. This industry is highly competitive and concentrated, compared to other product categories within the food and beverage market. The global flavours market is predicted to grow at a Compound Annual Growth Rate (CAGR) of 2% per annum.

This book majorly deals with flavour in fruits and vegetables, additional pathways for vegetable flavour, change in food flavour after processing, flavours formed via fermentation, odd flavours in foods, odd flavours due to chemical changes in the food, relationships between the food and flavour manufacturers, flavour characters of herbs preparation of herbs for marketing, flavour constituents of grapes and wine, dried inactive yeast powder, synthetic flavouring materials, flavour potentiators, baked goods and bakery products, sugar and chocolate confectionery, techniques of sensory testing, fruit based products, gas chromatography, microbiological analysis

The present book contains formulae, processes of various flavours applied in food and beverage industries. This book is intended to be a practical companion to the flavourist, technologists, entrepreneurs, libraries or for those who are already in the field of manufacturing.

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Application of Flavouring

The term flavour is widely used throughout this book and has several meanings depending on its context. Here, flavour is regarded as the summation of sensations induced by chemical compounds present in what we eat and drink and in equillibrium at the time of consumption. Some of these flavour components arise from normal bisynthetic process of animal and plant metabolism and hence are present in the basic nutritional constituents of our normal diet. Other components exist only as precursors and develop characteristic flavouring effects during subsequent cooking or processing due to chemical reactions induced by the effects of heat or fermentation. Some may be intentionally incorporated as flavourings at an appropriate stage of product processing or used as condiments when the product is served. Whatever the source, the observed odour and flavour impact of the end product is the total effect of the individual flavouring components present which in turn is determined by their relative proportion and their flavour rating.

Flavours in Foods

The flavour of foods may be classified as (a) natural flavour preexisting in the diet, particularly in fruits, vegetables and spices; (b) process flavour; arising in end products as a result of conventional processes including heat and fermentation; (c) compounded flavour: intentionally added flavourings formulated to produce a desired sensory effect., using selected flavourants of natural and or synthetic origin; (d) taste modifiers: additives which affect the basic taste sensations (e.g., salt, natural or synthetic sweeteners, food acids and bittering agents) and (e) abnormal flavours and taints: odd-odours and odd-flavours arising in products as a result of degradation, adventitious contamination or package/product interaction.

The flavour of what we eat and drink is not, in most instances, a static attribute but one which is in dynamic equilibrium, capable of change depending on many factors. In raw materials of both animal and plant origin, it changes during growth and maturation and further during postmortem or postharvest handling and preparation for market. Flavours arising from cooking depend on the time/temperature ratio employed in the preparation of the food. The flavour of the freshly prepared product may undergo further modification during subsequent storage. Microbial growth in products may produce significant flavour changes; some of these are desirable (e.g., dairy products), most are detrimental to product acceptability (e.g., souring of meats). Flavour changes within the end product may be due to (a) chemical transformation induced by pH, Maillard and related reactions, hydrolysis, oxidative rancidity, enzymatic or microbiological activity, etc.; (b) volatile losses which upset the relative concentration of aromatic constituents; (c) the removal of flavour components by selective absorption onto solid surfaces within the product and (d) differential partition between aqueous and lipid phases which significantly affects flavour perception.

Because there are so many variables, the formulation and production of foods and other comestibles is far from a precise science and depends to a large extent on subjective trial and error assessments to achieve a product profile having either maximum consumer acceptance or minimum consumer rejection. It is well recognized that flavour plays a significant part in product acceptance by inducing hedonic responses and hence consumer satisfaction or dissatisfaction. Poor flavour is a major cause of product rejection.

Achieving Flavour Balance

The control of flavour in an end product is one of profile alteration, which includes (a) the selection and balancing of existing or potential flavour factors working within the constraints of nutritional necessity, the nature and sources of the basic raw materials and supplementary ingredients and the total concept of the end product; (b) the adjustment of the flavour profile resulting from the method of processing employed to suit particular palates or consumer anticipations; (c) corrections to overcome any preexisting or developed flavour defects and (d) the imposition of an entirely new flavour in products which are bland or relatively

flavourless.

Each of these actions calls for individual judgment on the part of the product development team and involves the knowledge of available raw materials, minimum and optimum processing conditions, legal constraints and probable consumer response to the final product. This is the true basis of the culinary art and applies equally to domestic and industrial-scale food preparation.

Consumer Acceptance

The real judge is, of course, the consumer, but in accepting this one has to appreciate that the majority of the consumers neither knows nor really cares about the many problems encountered within the food industry from product conception to ultimate consumption. Not least of these problems are in the realm of flavourings, for example, the form in which the flavouring is to be incorporated, the flavour contributions of its constituent parts, the interaction of flavouring effects within the product, variability of sensory perception, the problems of compatibility, the complexity of flavouring systems necessary to achieve optimum flavour balance under far from ideal processing conditions, payload protection, and satisfactory release characteristics which liberate locked-in flavours. These and many other problems all affect the ultimate flavour profile and deÂ-termine the success or failure of the end product.

Flavour Defects

It is the correction of flavour defects which poses the greatest problems for the industrial food processor who must always aim at the maintenance of product quality which gives consistent consumer satisfaction. The following are available methods: (a) regulation of the processing conditions as flavour quality is often reduced by excessive heat or agitation; (b) incorporation of flavourings and/or other permitted food additives to achieve either flavour modification, intensification or suppression and (c) use of garnishes, sauces and condiments to suit individual palates at the time of eating; action more suited to domestic food preparation than commercially produced food products which are judged on their own attributes.

Flavour Intensification

Flavour attributes may be intensified by concentration or addition of a concentrate of the same flavour (e.g., tomato paste added to canned tomatoes); the incorporation of ingredients of a similar or supporting flavour profile to enhance and extend an existing flavour attribute (e.g., use of almond essence in cherry pie filling); the addition of compounded flavourings as topping notes to replace those lost during processing (e.g., imitation coffee aroma added to instant coffee); or the judicious use of flavour potentiators (e.g., MSG, ribonucleotides or maltol).

Flavour Suppression

Flavour attributes may be suppressed by removal of the unwanted character by further processing or maturation; incorporation of adsorbent materials (e.g., starch); neutra-lization or conversion of the flavour impact by adjustment of the pH or of the salt/sweet/acid balance; dilution with nonflavourful ingredients; masking, or disguising the undesirable flavour attributes by using stronger flavourings (i.e., spices and seasonings in meat products). The most appropriate technique to use may have to be established by trial and error and even then may only be partially successful.

Criteria for Application of Flavourings

Flavourings may be added to food and other consumable products for various reasons, but mainly (a) to impart flavour to an otherwise bland product-the flavouring may be in imitation of an existing natural flavour or may be created to give some desirable flavour experience; (b) to impose a different flavour character from that arising from basic ingredients; (c) to boost weak intrinsic flavours or replace flavour notes lost during processing; (d) to modify or complement an existing flavour profile; (e) to disguise or cover undesirable flavour attributes; (f) to overcome seasonal variability in natural flavouring materials or constituents; (g) to impart a flavour where the use of a natural flavouring material is technologically

impracticable; (h) to make available at an economical price the flavour of natural materials which are either of limited availability or are unacceptably expensive and (i) to make available flavour types where the natural product poses toxic or other hazards.

One of the major functions of intentionally added flavourings is to extend the range and flexibility of food products and processing technology, but their specific application is determined by factors which are not exclusively technical in character. These include the following.

Acceptability to the Consumer

The flavour of food, drinks, candy, chocolate confectionery and snack foods is open to wide hedonic interpretation. Preferences display a wide spectrum of response depending on such factors as ethnic origins, education and upbringing, age, sex, environment and even one's personal mood at the time. The strength and quality of flavours in end products are often regionalized. This poses a big problem to the manufacturer aiming at national distribution and even greater problems if international markets are being considered. Indeed, this desire to please everybody often results in the development of less than top quality products aimed at minimum rejection over a wide market area rather than products having maximum acceptance in a smaller regional market.

Legal Acceptability

This is of increasing concern to the food manufacturer and in most developed countries, the use of flavourings is controlled by legislation aimed at safeguarding the consumer from real or supposed health hazards arising from the ingestion of materials intentionally added to the natural diet. A secondary aim is the prevention of fraud and deception as to the true nature of the products which the consumer must, of necessity, take on trust. It is essential that any food product, beverage, etc., should comply with the legislation of the country in which it is offered for sale and this does not necessarily equate with that of the country in which it is manufactured. Ignorance of the law is no defense.

Nature of Product as Sold and as Consumed

Today, the range of consumable products is enormous resulting from a rapidly advancing processing technology based on computerization and automation, imaginative product conception to meet consumer needs for speed and convenience without loss of nutritional values, versatile packaging and efficient and safe distribution and marketing. The form of the product will obviously determine the form in which flavourings may be incorporated-dry goods call for powdered flavourings and wet goods enable one to use flavourings in liquid form. Many products require further preparation and cooking by the consumer. Here, one generally has little or no control and the chances of product failure are great, hence, preparation instructions must be simple and precise. Even so, some allowance should be made for indifferent domestic handling and it may be desirable to set flavouring levels a little on the high side as excessive cooking, which is the usual problem, can seriously reduce available flavour content to the detriment of the product when consumed.

Processing Conditions

These are of major importance, but from the point of view of deciding what is the most appropriate form of flavouring as well as the flavour profile of the end product, the product development team must be able to produce a facsimile of the end product under laboratory or pilot plant conditions closely similar to those encountered in full-scale production. This is the only sure way of establishing the technological and aesthetic acceptability of the end product. Evaluation of flavourings in alternative test media may be adequate as a first-stage screening but such assessments may be quite misleading in relation to the final product.

Available Flavourings

Each of these areas of constraint is complex and makes very special demands on flavour manufacturers in

the industry's service to food processors. Individual flavouring compositions must reflect consumer tastes and indeed prejudices, as well as cater to unpredictable and often short-lived demands, particularly in the fields of snacks, confectionery, ice cream and soft drinks. Flavourings must be compatible with other prime constituents in the end product, be resistant to often adverse processing conditions and be stable before during and after incorporation into the finished product.

Very few flavourings are suitable for all applications as processing conditions vary widely in physical parameters, particularly temperature. In addition, the physical character of the end products often pose unique problems of flavouring incorporation and subsequent flavour stability. Few genera-lizations are possible in such a diverse field so that a study should first consider the general processing constraints common to the food industry and then examine products by groups in which the processing parameters are broadly similar. By this means, one can highlight the problems and indicate the methods currently used to achieve satisfactory flavouring application.

Processing Parameters

Unit operations encountered in the processing of foods, beverages, baked goods, sugar and chocolate confectionery, meat and other consumable products are relatively few and details can readily be obtained from the many excellent texts on process engineering. These are mainly associated with raw material preparation, mixing and blending, thermal processing involving various methods of cooking, the retorting of cans or pouches, refrigeration and deep freezing, dehydration, gamma irradiation and packaging. Within these processes, the following conditions are the most important determinants likely to affect the incorporation of flavouring materials and the flavour profile of the end product.

Temperature and Time

By their aromatic nature, most flavouring materials are to some extent thermolabile or heat sensitive. At elevated temperatures, particularly in the presence of water, they may be lost to the system through evaporation or steam distillation. Less stable compounds may change due to chemical interactions with other constituents. The degree of change is usually a function of both temperature and time. The effects of ultraÂ-high temperatures for very short time intervals may result in significantly less flavour loss or degradation than occurs with much lower temperatures employed over a longer period, although this will depend on other factors internal to the product (e.g., pH, the presence of proteins). A knowledge of the temperatures to which the total flavouring system will be exposed and the dwell-times involved are most important in deciding the nature of the flavouring to be used particularly with respect to any solvents present in systems subjected to temperatures in excess of their boiling points. It should be remembered during laboratory or small-scale product development that large bulks often retain their heat disproportionately to small quantities and this too may have a deleterious effect on the flavour level and profile.

The effects of heat processing are most obvious in products containing both sugars and amino acids as these are susceptible to nonenzymatic browning, which has been discussed elsewhere. Also, those containing high levels of lipids become prone to oxidative rancidity at even moderately elevated temperatures and these changes generally result in quite unacceptable odd-flavour notes.

Open or Closed System

The incorporation of flavouring materials in an open system (i.e., blending in an open vat) is likely to result in greater volatile losses than in a closed system (i.e., in-line processing or retorting in sealed containers). Where open handling cannot be avoided, every precaution should be taken to minimize exposure by using covered containers and avoiding exposure to direct heat. The bigger the unit bulks and the higher the temperatures employed, the greater the chances of flavour loss or degradation.

The Mixing Sequence

The guiding principle is to expose any added flavouring to the minimum of treatment. Obviously, in some products addition into the primary mix cannot be avoided, but wherever possible, flavourings should be added at as late a stage as consistent with uniformity of dispersion in the end product.

pH

Most fruits contain natural organic acids (e.g., citric, malic, tartaric adds) which contribute significantly to the flavour profile. The use of acidulants is necessary when one is using an imitation fruit flavouring the taste of which is intrinsically neutral; otherwise the correct flavour impression, is not achieved in the end product. Some flavourings and certain spices (e.g., turmeric) contain ingredients which are sensitive to changes in pH and it is essential that this particular condition be carefully reproduced during the product development stage and subsequent shelf-life testing to ensure that undesirable effects do not occur.

Pressure

Both positive and negative pressure changes are likely to endanger added flavourings by altering the relative concentration of aromatic components in the headspace vapours. Vacuum filling may result in the more volatile components being preferentially lost from the system resulting in an unbalanced profile in the end product.

Contact with Air

This is of particular concern in products which are aerated (e.g., ice cream, marshmallow). High-speed mixing operations can result in considerable volatile losses, but, more importantly, any occluded air produces conditions conducive to oxidation of any unsaturated lipids present. The pneumatic conveyance of powdered flavouring ingredients and food mixes containing flavourings (e.g., soup mixes, instant puddings and dessert powders, sauce mixes) may also result in significant volatile losses unless encapsulated flavourings or seasonings are used. A similar consideration applies to flavourful products predispensed into vending machine containers as the exposed surface area is comparatively large.

Specific Flavouring Applications

It is necessary now to review some of the practical implications of the above generalizations as they affect specific product groups. The food and related processing industries cover an enormous field of processing technology particularly when one appreciates that there are many subgroups calling for individual consideration. The details of flavour application, particularly the plant involved, must be left for specialist study.

Meat Products

This group of products embraces all types of meat, meat by-products, poultry and fish. Although the greater proportion of these commodities is sold for domestic preparation, it is that which is industrially processed which most concerns us here. The resulting products include fresh, semi-dried, dried, fermented, deep-frozen and canned meats which may be eaten directly either cold, after reheating or after some further domestic preparation or cooking. The opportunities for using added flavourings are almost limitless but the diversity of product types, many of which are now traditional, imposes considerable constraints on the nature of any added seasoning or flavouring materials. In addition, in many developed countries, the meat industry is controlled by legislation which is either separate from or supplements food legislation so that special regulations may govern the nature and quality of any additives.

In savory foods, the prime taste adjunct is salt and its level is significant to the shelf life of many products and in the total flavour profile as it affects product palatability. Additional flavouring effects may be achieved by using seasonings. This is an indusive term applied to any ingredient which by itself or in combination adds flavour to a meat product. Most seasonings are blends of natural herbs and spices, or products processed directly from them, often admixed with other flavouring ingredients such as MSG, the ribonucleotides and hydrolyzed vegetable protein all of which may enhance or impart characteristic meaty

notes to the product.
Different animal tissues vary considerably in moisture: protein ratios; fat: lean ratios, the amount of pigment present and in their water and/or fat "binding" properties. This spectrum of variables means that the careful selection of meat ingredients by type and quality is basic to the manufacture of most meat-based products and particularly to the production of sausages and other comminuted meat products.
The basin technology of meat processing is complex and often specific to a country, a manufacturer, or, indeed, to an individual product line. Whatever the process, the following factors must be taken into account when selecting an appropriate seasoning: (a) the nature of the raw materials used, particularly the lean: fat: water ratio; (b) the nature of any pretreatment, particularly the use of curing agents; (c) the stage and method of incorporating the seasoning; (d) the degree and nature of any comminution stage; (e) post-mixing treatment, particularly that involving heat (i.e., cooking, smoking, drying or retorting); (f) the temperature and times involved at any stage, particularly in an open system; (g) the nature of any added preservatives, particularly sulfur dioxide; (h) methods of packaging, particularly if this involves exposing the product directly to a vacuum and (i) post-packaging handling and storage, particularly refrigeration or deep freezing.
This, you will appreciate, implies a precise knowledge of the end product and its method of manufacture and on this, one cannot generalize.
The principal aim in incorporating seasonings into meat products is to impose added flavouring notes which will enhance the natural meat flavours developed during cooking; maybe modifying them to suit individual tastes but not swamping them. Traditionally, seasonings have been prepared from herbs and spices ground to varying degrees of fineness. For most purposes such products should pass through United States Standard Sieves of No. 20-No. 60 mesh. There is a demand for much finer products or what are called "micro milled" spices for use in certain sausage emulsions. Numerous articles have appeared in the technical literature and their several advantages and disadvantages are listed.
Increasingly, the industry has adopted seasonings based on spice extractives-the dispersed or "soluble" spices which give a standardized flavouring effect. Such commercially compounded seasonings are generally in the form of dry powders comprising not only the appropriate herbs and spices, but also other permitted additives which may include flavour enhancers, hydrolyzed vegetable protein, yeast extracts, salt, phosphates and colourants. They are frequently supplied preblended in unit packs to facilitate addition to a single processing bulk at the chopping stage. To overcome volatile losses from such products, several spice houses now offer seasonings based on spice extractive encapsulated by spray drying. These have a considerably longer shelf life and in many uses are preferred.
With an increase in automated processing with computer-controlled dosing of ingredients, the use of seasonings in the form of liquid emulsions is rapidly gaining in popularity. These have all the advantages of the dry processed products but can be accurately metered in-line and almost instantly and uniformly dispersed into the prepared meat emulsion. They are more concentrated than powdered seasonings and many are designed for use at 2 g/kg of meat mix. Precise usage level should be established with the supplier. The presence or absence of added preservatives will dictate whether or not the product is supplied in a single unit or multi-dose pack. The processing of poultry and fish calls for a very specialized technology which lies outside the scope of this text but the manufacture of comminuted products such as "chicken burgers" or "fish cakes" involves considerations similar to those just described.

Baked Goods and Bakery Products

This important branch of the food industry embraces such widely different products as bread and rolls, sweet yeast dough produds, biscuits, cookies and crackers, pies and pastries, cakes and even breakfast cereals. All of these are based on flour, mixed as necessary with sugar, eggs, milk, shortenings, leavening

agents or yeast, antistaling agents and flavourings. The industry covers an enormous range of specialty products many of which involve purpose-designed plant and processing techniques.

The following constraints will determine the choice of any flavouring: (a) the effects of temperature and time; (b) flavour balance, particularly acidity and sweetness; (c) stability on storage, particularly related to the moisture content of the end product and (d) the nature of any leavening agents used, particularly if this is active yeast.

Within this product group, flavourings may be incorporated in one of four ways: (a) mixing into the dough or batter prior to baking; (b) spraying onto the surface of the product as it emerges from the oven; (c) dusting onto the surface after cooking and oiling and (d) introduction into the cooked product as a cream filling, glaze or coating.

Of these, baked-in flavours pose the greatest problems both of volatile losses and flavour change. Baking involves very high temperatures and relatively long dwell-times and these conditions place a great constraint on the use of any flavourings in the dough or batter. Since flavourings are volatile, usually a considerable proportion of an added flavouring is lost during the baking process. The extent of these losses is usually determined experimentally and an additional quantity added to give the desired flavour level in the end product. The dosage level of any added flavouring should be adjusted carefully as overflavoured baked goods are much less attractive than underflavoured. The colour balance in the end product is also important and the use of combined flavourings/colourants is not recommended as this may restrict dose adjustment. The number of really satisfactory flavours is strictly limited. In practice, it has been found that the use of fat or oil-based flavours reduces losses. With liquid flavourings it is advisable to use a nonvolatile solvent such as propylene glycol (where this is permitted) and to premix the flavouring with any fat present in the formulation. Heat resistant powder flavours made by multistage encapsulation are commercially available and are very effective under these harsh conditions. The secondary capsule, being water insoluble, ensures that such products resist breakdown during the preparation of the wet dough and melt to expose the primary capsule only during the later stages of the baking cycle. At this stage the water content of the product is too low to result in a full release of flavour which only occurs when there is an excess of water, such as in the mouth during chewing. Although these encapsulated products may appear initially expensive, they have a reduced use level which makes them a viable flavouring source.

Flavour emulsions are particularly suitable for use in bakery mixes although care must be taken in their incor-poration into such products as foam-type cakes (i.e., sponge and angel cakes) as the essential oils present may cause the foam to fall back if beaten with eggs or egg whites. Flavouring emulsions should be added by gentle stirring or folding just before the flour is added. Fillings for use in baked goods may be either dairy cream, butter cream, fondant, custard, glazes or jellies.

Snack Foods

Snack foods in this context will be taken to include both potato chips and extruded products based on various farinaceous materials, as biscuits, chocolate-based snacks and instant snack meals are better considered in other product groups. In the case of chips, flavouring is limited to surface dressing or dusting and many specialty flavours such as salt and vinegar, barbeque and smoky bacon are widely popular. Chips made from reconstituted potato starch offer a great opportunity for including the flavour in the dough prior to cooking.

Extruded products pose additional problems and flavouring is accomplished in two ways: (a) incorporation of the flavouring into the dough or premix prior to extrusion, which will be influenced by whether it is a hot or cold extrusion process and (b) external application by dusting or coating.

Cold extruded products such as pasta are best flavoured by using emulsions added to the system with the formula water, although preblending of a spray-dried flavour with the flour portion is also quite acceptable if

somewhat more tedious.

Hot extrusion is a very efficient method of manufacturing a wide range of foods based on corn, oat or wheat flour or vegetable proteins or mixtures of both, and the technique is described by Smith. The processing parameters are very severe as in most extruders, the mix is exposed to high pressure (500-900 psi) and very high temperatures (1200-1760C or even higher) followed by a rapid steam flash-off as the product expands on leaving the extruder nozzle. It is necessary for the product then to be dried to about 8% residual moisture. Such conditions cause evaporation of a significant percentage of flavour volatiles and impose severe constraints on the type of flavouring that can effectively be used. Acceptability is generally one of trial and error under the exact processing conditions envisaged.

In the case of thermal reaction flavours, e.g., meatlike flavour) based on the Maillard and related reactions between sugars and amino acids, the precursors may be added to the premix and allowed to react during the extrusion, although variations in processing conditions may well result in unacceptable nuances in the achieved flavour profile. The preparation of meat analogs based on soya flour poses somewhat different problems as here it is essential that no residual soya flavour should remain in the end product.

The applicatioh of surface dustings is very widely used but the method is not without its problems. Numerous ingenious application techniques have been described in the literature. Savory flavours, particularly those containing hydrolyzed vegetable protein, yeast extract, cheese and onion powders, are usually hygroscopic and under factory conditions readily absorb atmospheric moisture and tend to cake and become sticky. This leads to uneven distribution and a blocking of the application machinery. From a consumer's point of view, surface-applied flavours are only satisfactory where the base product is acceptably flavourful and far less so when the product is flavourless, as in the case of most extruded snacks.

The use of residual surface oil or oil sprays poses limitations, not only on the nature of the dusting but on the shelf life of the product as rancidity readily sets in. Even in well-sealed packs, the shelf life of such products is strictly limited. The use of electrostatic applicators, which avoid the use of oil, is now proving to be a much more acceptable method than tumbling or air blowing.

Sugar and Chocolate Confectionery

The processing constraints which determine the most suitable flavourings for use in sugar confectionery are so diverse that each warrants separate consideration. A detailed examination of each product group is outside the scope of this text and reference should be made to one of the standard works covering this industry. The main sectors involved are high-boiled confectionery (i.e., hard candy); low-boiled confectionery (i.e., chewy caramels); starch-deposited confectionery (i.e., pastilles); chewing gum and chocolate.

The list of available flavourings is comprehensive and most flavour manufacturers readily supply usage data applicable to the various end-product groups concerned. Some flavourings on their own are quite flat and lifeless even if they do have an impressive aroma. Fruit flavours generally need the support of citric, tartaric, malic or lactic acids in amount varying between 0.25 and 5% depending on the nature of the end product.

In confectionery products where added flavour is paramount, choice is critical and one must try for the most natural eventhough the use of entirely natural flavourings is not practicable. Excellent imitations of most natural flavours are now available with a wide choice of nuances to give any desired profile. Using flavour in unusual combinations is rarely successful as consumers are very conservative.

In modern confectionery manufacture, continuous and automated processing is replacing the long-established batch methods and the new parameters impose special constraints on any added flavouring ingredients. In most plants, the flavouring is injected into the cooked sugar mass as it moves through the

system, hence mixing time is strictly limited and, for uniform flavour effect, ease of dispersion is critical. Flavourings must withstand 154ÂºC for a relatively short period but much longer dwell-times at 1400C are not uncommon. Such conditions can induce undesirable profile changes. The need to use vacuum for deaeration also leads to flavour loss and it is usual to add upto 25% more flavouring than would be necessary in batch processing in order to achieve the same sensory impact in the end product.

Chocolate manufacture is very much something for the specialist but even here added flavourings have a part to play (a) to modify the flavour of the basic chocolate mass (e.g., the use of vanilla extract, vanillin or ethyl vanillin) to give a rounded smoothness to the profile; (b) to impose an overriding but compatible flavour (e.g., orange, rum, peppermint), and (c) to flavour fondant-based or other centers. (d) the percentage of lipids present in the product, as partition can significantly affect flavour perception; (e) hygiene, as flavours are often added after pasteurization they must be micro-biologically acceptable, and (f) stability under pasteurizing conditions.

It must be remembered that these products are eaten cold and that this has a marked impact on flavour perception due to "freeze-out" and resulting fading of flavour impact. There is an enormous range of flavourings available for use in ice cream, including naturals such as cocoa powder, fruit pastes, natural extracts and essences, particularly vanilla, and, of course, imitation flavourings. The profiles of these are legion and synthetic chemicals such as vanillin and ethyl vanillin together with ingredients such as fruit pieces, nuts or crystallized fruits are almost universally used.

When checking the usage level of any flavouring material, it is essential to establish the degree of overrun which, for ice cream, is generally 70- 80%, but in water ices may be as low as 25%. This obviously will have a considerable impact on the flavour level in the end product.

Ice cream contains milk solids so that highly acidic flavours will tend to precipitate casein and so ruin the texture of the end product. Frozen mousse is in effect an overstabilized ice cream containing considerably more gelling agent than would normally be required in a standard ice cream mix. This extra gelling power means that casein precipitation is not a major problem hence, mousse formulations can contain much higher levels of acids than are possible in ice cream in order to achieve a truer, full fruity, flavour profile.

Soft Drinks

This product group includes carbonated beverages, both clear and cloudy; noncarbonated or "still" products such as squash and cordials usually concentrated and requiring dilution by the consumer; specialties such as ginger beer, root beer; and the various cola products and "crystal" beverages which are in powder form requiring reconstitution with water.

Flavourings for such a diverse product group must (a) impart the characteristic profile implied by the name; (b) be technologically compatible; (c) be stable to heat, light, acids and preservatives, particularly sulfur dioxide; (d) impart the correct physical appearance to the end product; (e) be free from spoilage organisms and (f) comply with existing legislatio
n.

Their application is, of course, dictated by the nature of the beverage as ready for drinking. Many flavouring materials are either insoluble or only very sparingly soluble in water, so that special techniques have to be employed to ensure a uniformly flavoured and stable product. Two widely used methods are the following: (a) They can be dissolved in a permitted solvent so that when added to the concentrated bottling syrup and ultimately diluted with water, they remain in solution. (b) They may be emulsified. Such flavourings are generally used to produce a cloud in a drink which would otherwise be clear.

Fruit and berry juices are widely used as flavour bases for soft drinks and most of these are concentrated by the removal of water under vacuum to give a commercial product which is between four and six times stronger than the original juice. The flavour value of these concentrates depends not only on the degree of

concentration but on the precise processing conditions used in their manufacture. From an application point of view, fruit products may be offered in sealed containers which have been pasteurized, in which case the whole contents must be used once the container has been opened, or they may be in multidose containers, the contents of which contain a permitted preservative, usually sodium benzoate. All fruit-based flavourings are best stored under refrigeration or in a cold store.

Finished soft drinks have a specific gravity of about 1.05, whereas, the flavourings usually contain essential oils having a gravity of less than 1.00. To achieve a stable suspension on dilution it is necessary to "weight" the flavouring components. Formerly this was done by the use of a much heavier brominated vegetable oil but the use of this and other weighting agents (e.g., ester gum) is now restricted by legislation which varies considerably between countries. Flavouring manufacturers have attempted to overcome the problems of "ringing" in various ways and can best advise on the optimum usage of their flavouring emulsions.

Crystal beverages offer few problems in flavour application. They fall into two broad categories: (i) high quality products made from sprayÂ-dried fruit and (ii) cheaper, lower quality products, based on imitation flavourings. A typical formulation contains sugar (62%), dextrose (24%), citric acid (7.5%), sodium citrate (1%), ascorbic acid (0.2%) together with a dry flavouring and an appropriate colourant (Heath 1978). The use of encapsulated flavours is recommended as these give a long shelf life. Where a cloudy product is desired, a spray-dried vegetable oil may be incorporated into the above formulation at about 4%.

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