Session D Round Table Discussions

Flavor Problems in the Application of Soy Protein Materials

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ABSTRACT

A brief description is given of natural flavors in soy products. Also, addition of new flavors as well as overcoming natural off-flavors is discussed.

INTRODUCTION

A person of good taste is someone who enjoys the good qualities of life. Similarly, a good quality food can only be enjoyed if it has a good taste. And although food, of course, is necessary to sustain life, the pleasure we derive from eating determines largely the quality of life.

In other words, flavors are very important in our appreciation of food. Therefore, when new food ingredients are being offered, it is not just their nutritional aspect, functionality, and price that determines their applicability. Flavor plays a major role.

In the marketing of soy protein materials for human consumption, nutritional value, functionality and price have generally been emphasized. However, the flavor problems have been neglected and underestimated. There exist some major problems: first the off-flavors inherent in soy, and second the absence of an attractive positive (e.g., meat-like flavor).

OFF-FLAVOR

The off-flavors have been discussed by Mr. Rackis in the plenary session. Table I summarizes the various off-flavor categories with the compounds and precursors held responsible for them, as well as methods to remove them.

In general, proper refining techniques (e.g., alcohol extraction) are required to yield bland soy protein materials; they can be used as an ingredient for use at high levels and under demanding process conditions.

FLAVORING OF SOY PROTEIN PRODUCTS

In the flavoring of the bland soy protein materials, there are two problems: first, which type of flavoring materials should be added and at what levels; and second, how they should be added in order to have an optimum effect. The latter problem, the so called release problem, shall be discussed first.

Flavor Release

It appears that a flavor added to a bland textured soy protein product is released much faster than in, e.g., a similar piece of meat. This must be attributed mainly to a difference in texture, where in the soy material during mastication the flavors are expelled during the first bites, whereas in the tougher meat system the release is far more gradual. This is particularly true for water soluble flavor compounds, and unfortunately many meat volatiles and certainly the taste compounds are water soluble.

For such compounds incorporation before texturing or addition during hydration makes hardly any difference. For fat-soluble flavors, e.g., ham and chicken volatiles, the release is much slower, and hence incorporation before texturing will be beneficial, provided of course, the flavors are stable with the texturing conditions.

The practical solution for the release problems are: restriction of textured materials to a small particle size to avoid prolonged chewing, or an intensive blending with the other ingredients in the food, e.g., comminuting or mincing together with the meat. Longer term, better textures must be developed which must be more complicated to have an interesting mouthfeel; this means more elaborate texturing procedures and use of more ingredients than just soy.

Type of Positive Flavors

Selection of flavors to be used with soy protein material is more difficult than it seems.

First, the type of flavor required is highly dependent on the level of incorporation of the protein product. At low levels a flavor enhancer will probably suffice, whereas at very high levels a complicated mixture, comprising taste compounds, precursor systems, and volatiles will be re-

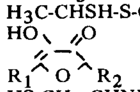
TABLE I

Off-flavors in Soy Protein Materials

Off-flavor	Compounds responsible	Precursors	Prevention/removal
Bitter taste	?	Phosphatidyl cholines	Alcohol extraction
Sweet taste	Sucrose	---	Water extraction
Green, grassy ordors	Carbonyl compounds	Polyunsaturated fatty acids + lipoxygenase	Hexane extraction Heating, intact beans
Cooked soybean ordors	p-vinyl phenol p-vinyl guatacol	p-Coumaric acid ferulic acid (lignin)	Low heat treatment Alcohol extraction
Burnt flavor	Ketones, aldehydes furans, sulfur compounds pyrazines	Amino acids + carbohydrates (Maillard reaction)	Low heat treatment Water extraction
Catty odors	4-methyl-4-mercapto-2-pentanone	Acetone + hydrogen sulphide	Solvent removal
Fusel note	Long chain alcohols	---	Solvent removal

TABLE II

Maillard Intermediates as Flavor Precursors

Formula	Compound
HO-CH_2-$(CHOH)_n$-CO-CH_2-NH-CRH-COOH	1-amino-1-deoxy-2-ketose (Amadori rearrangement product)
HO-CH_2-CHO	Glycolaldehyde
CHO-CHO	Glyoxal
CH_3-CO-CHO	Pyruvaldehyde
HO-CH_2-CO-CH_2-OH	Dihydroxyacetone
HO-CH_2-CHOH-CHO	Glyceraldehyde
CH_3-CHOH-CO-CH_3	Acetoin
CH_3-CO-CO-CH_3	Diacetyl
CH_3-CO-CO-CH_2-OH	Hydroxydiacetyl
H_3C-CHSH-S-CH_3	1-methyl thio ethanethiol
	Hydroxy furanone
HS-CH_2-$CHNH_2$-COOH	Cysteine

quired to give the right impact.

Second, interaction frequently takes place between flavor compounds and the soy proteins, which may lead to a change in character of the flavor. Especially the interaction with some spices has a dramatic effect, sometimes leading to new off-flavors.

Third, when flavors are added before texturing, the heat treatment may change the character of the flavor. Hydrolyzates and reaction flavors are generally a failure as they turn into a burnt and bitter taint.

An elegant way to incorporate positive flavors in a bland soy protein material is to utilize the Maillard reactions, which in many heat-treated foods are responsible for flavor formation. Suitable precursor mixtures can be added to the soy protein material before extrusion in such levels that the texturing process provides the right conditions for the reactions. The optimum precursors are well known intermediates in the Maillard reaction, like short chain aldehydes and ketones, sulfur compounds, or cysteine as a hydrogen sulfide releasing agent, and furanontes. Some examples are listed in Table II.

The use of Maillard reaction intermediates provides a promising method to utilize the texturing process for incorporating positive flavors in refined soy protein products.

The Role of Processing in Changing Protein Characteristics

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ABSTRACT

In our efforts to design and produce proteins which deliver optimal benefits in products both reproducibly and cost effectively, we must keep in mind the following points. Protein "functionality" is only meaningful in a specific product and process context. Techniques are becoming available to investigate "molecular protein characteristics;" how we can best use them to understand how proteins contribute to "product attributes" remains to be elucidated. Different proteins respond differently to typical process regimes. Use of these proteins as functional ingredients may require formulation or process modifications.

The underlying theme of this presentation is embodied in the question: "Is it possible to relate protein molecular characteristics to the observed contribution of those proteins to product attributes, in a way which is both meaningful to the ingredient supplier, and to the product developer?" Therefore, I shall draw attention to some experimental observations which seem to be – intuitively at least – perhaps to relate to this rather fundamental question. What I shall not do is present hard data which could suggest that the answer is an emphatic yes!

In any food product, the consumer-perceived product quality reflects many interrelated factors. Two of the most important are: (a) the juxtaposition of the different components – fat, meat fibres, water etc. – which have intrinsically different textural characteristics, (e.g., hardness, juiciness) as well as different economic parameters; and (b) the strength of the interactions, or bonds between the ingredients, which underlies how the components will hold together during processing and product manufacture, and will then be broken down during consumption by the consumer. In theory at least, the key contribution of protein to the consumer-perceived attributes of food products reflects: the intrinsic *molecular characteristics* of the protein, e.g. molecular weight, amino acid composition, sequence etc.; the *processing history* of the protein both to become a discrete ingredient, and/or during product manufacture; the physical and chemical *environment* of the protein ingredient, at all stages during isolation and utilization.

TABLE I

Protein Characteristic or Functionality Evaluated-Fat Stabilization (e.g., for Meat Products)

Approach adopted:

a.) Evaluate technical performance of a range of proteins, under simulated product and process conditions.
b.) Determine "molecular protein characteristics" by appropriate physical techniques, such as, N.M.R. – availability, flexibility of apolar residues; D.S.C. – "conformational state" of the proteins.
c.) Correlate observations from a.) and b.).