Aroma Production and Application in Food Products

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1. Introduction

Aromas have a large application in industry processing, especially in food production. As the food additives they influence sensible the process of consumer decisions, because smell is fundamental parameter to value the food quality and to differentiate the food types [Zawirska-Wojtasiak 2005]. To cope the consumer needs there are many works, that aim to achieve the food of better sensory characteristics. There are many technologies of aroma production, that base on the physicochemical, chemical and biotechnological processes [Grajek 1999]. Nowadays issue of safety food production is very important because of human health. That is the reason, why biotechnological methods of aroma production gain more popularity. The aromas obtained in biotechnological method are called bioaromas. In the bioaromas' production there are used microbiological, enzymatic and tissue culture methods as well [Kociszewski and Szwacka 2006]. Recently scientific works concern on the bioprocess' optimization, especially bioconversion, that is the basic tool in the bioaromas production.

2. Aim

The aim of this paper is presentation of aroma production methods focused on the biotechnological processes. I this summary are characterized aroma compounds and methods of aromas' package and storage as the decisive factors in aroma production.

3. Smell and taste

Smell is an elementary parameter in the food valuation. A term of aroma concerns the substance, that causes pleasant fragrances sensation. Food aroma is felt by sense of taste and smell by awaking the receptors of taste on the tongue and by smell receptors in the nasal cavity, that send information to the central nervous system and give a flavour sensation

[Swiderski and Waszkiewicz-Robak 2006]. Integration of these sensations is important. Sense of taste lets to difference between four basic taste types like sweet, sour, bitter, salt and their combination, but only cooperation with sense of smell it is possible to feel the flavour sensation. Deprivation of smell sensation causes a deprivation of characteristic marks of food. Smell matters more for flavour form than sense of taste [Bal and other. 1997; Zawirska-Wojtasiak 1999].

Substances of different chemical formation indicate their ability of aroma production, however small difference in their chemical formation might completely modify their characters. In process of natural sources transformation often occurs a partly deprivation of aroma or disadvantageous change of aroma, then his concentration is low at level of few or over a dozen milligram in 1 kilogram of final product. Cause of these changes are chemical transformation of some compounds [Góra 2000].

4. Aroma compounds

To the compounds, that cause aroma character, belong esters, lactones, terpenes, carbonyl compounds, ionones, mustard oils and pirasines.

The most popular ester of aroma production is ethyl acetate. A lot of aroma-esters occur at beer, where they are products of fusel derived alcohols and short chain fatty acids. Esters are also produced by participation yeast enzymes during a wine fermentation. There are known methods of aroma compounds biosynthesis with immobilized enzymes [Bednarski and Reps 2001].

Lactones occur in fruits, vegetables, nuts, milk and meats. Moreover lactones are obtained in biotransformation and synthesis reaction by participation of some microorganisms. The most recognized lactone is γ-dekalactone [Bednarski and Reps 200; Serra and other 2005].

Terpenes, called ethereal oil, occur mostly in every plants. They are gained by distillation plant's material by steam or by squeeze [Brud 2000]. Especially their derived find application in food industry like p-mentol, that is produced by chemical synthesis and microbiological transformation as well [Kączkowski 1982; Bednarski and Reps 2001; Sikorski 2002].

Carbonyl compounds are elementary aroma compounds in fermenting creamery products. They reacts with some amino acids and make aroma and taste compounds. Carbonyl

compounds are synthesize by bacteria of milk fermentation. The most popular carbonyl compound is diacetyl [Bednarski and Reps 2001].

Ionones are produced in the enzymatic hydrolyze of carotenoids. Mustard oils are obtained from isotiocyanides or from other odorless precursor by influence of myrosinase enzyme. Pyrasines are responsible for aroma of roasting products. Pyrasines are products of microbiological conversion of leucine, isoleucine and valine and moreover they appear in pepper, potatoes and in green pea [Sikorski 2002].

5. Methods of aromas production

There are many methods of aroma production, that are divided into three basic groups [Zawirska-Wojtasiak 1999]:

- biotechnological,
- chemical,
- and physicochemical.

Biotechnological methods are characterized by technical stimulation of the aroma production mechanisms. By use the microbiological, enzymatic and tissue culture methods there are produced the bioaromas, that are recently more popular in food industry [Zawirska-Wojtasiak 1999; Mor 1991].

Physicochemical methods concern to ethereal oil, distilled oil, that are deprived some compounds, and to isolates. Isolates are oil compounds, that are isolated with use the fractional distillation. Oils are obtained from different plant parts, like rind, leaf, twig e.g. cinnamon oil from plant *Cinnamomum zeylanicum Blume,* from fruits e.g. anise oil from *Pimpinella anisum L.,* from bloom herb e.g. lavender oil from *Lavendulla officinalis Chaix.* and from other parts of plant. There are also used thermal processes, that base on the technical stimulation of the aroma production mechanisms. Aroma are produced in Maillard reactions and in processes of lipids oxidation. Among many aromas obtained by use of that method there should be mentioned aroma of backing and boiled meat, aroma of roasting nuts, aroma of bread, beer, coffee and cacao [Zawirska-Wojtasiak 1999; Sikorski 2002].

Chemical methods of aroma production are most economical and base on the chemical synthesis, thereupon are gained the racemic mixture and then the homogeneous isomeric forms [Zawirska-Wojtasiak 1999].

Nowadays are carried many works, that aim to optimization and application of bioprocesses like bioconversion (biotransformation). Bioconversion belongs to natural

method of aroma production [Hilton and Cain 1990] because of use of natural precursors in such a processes like biocatalysis, fermentation and aroma isolation from plants and animal sources [Serra and other 2005]. Biotransformation is a biochemical reaction, that is catalyzed by microorganisms or by biomass' enzymes. Biotransformation methods are summarized in table 1. Bioconversion finds its application at creating of chiral centers, in conversion of functional groups with similar reaction chain and in regioselective function of carbon. To advantages of bioconversion belong [Leuenberger 1990]:

- specifity of reaction,
- stereospecifity,
- regiospecifity,
- mild conditions of reaction.

There are many applications of bioconversion in the bioaroma production, like bioconversion of cinnamic acid to acetofenone by bacteria *Pseudomonad* [Hilton and Cain 1990], production of fruits aroma like banana, pear, melon, apple and citrone by fungi *Ceratocystis fimbriata* [Bramorski and other 1998] or production of mushroom aroma by fungi *Penicillium camembert* [Husson and other 2003].

Table 1 Methods of biotransformation and their characteristics

Biotransformation with growing culture	**Biotransformation with already cultivated culture**	**Biotransformation with purified enzymes**	**Biotransformation with immobilized cells or enzymem**	**Biotransformatio n in diphasic liquid**
Substrate is adding to medium during his inoculation or during late growth phase. Growth and biotransformation are symultan; e.g. biokonversion 1-heptacarboxy acid to 2-heptanone by use *Penicillium roquefortii*[Larroche and other 1994]	Processes of biomass' propagation and biotransformation are divided. That simplifies a process control, like growth and bioconversion optimization, cell concentration control.	This metod is used, when substrate penetration through the cell membrane is insufficient or by appearance of undesirable side reaction with presence enzymes system.	By use of immobilized cells/enzymes it is easy to remove biocatalysts from reaction bullion and to use it again or to keep it in a reaction tool and to lead constant biotransformation process.	In liquid diphasic system one phase is water and the second one is organic solvent, that do not mix with water. That enable growth solubility of substrate and might protect biocatalysts, that prefers water environment against toxic effects. An example are enzymes in liotropic liquid crystalline).* [Miethe and other 1989]

Among used methods of bioconversion there is a biocatalysis to mention. Its application lets to obtained many natural and natural-identical aromas, because that process biocatalise many stereoselective and regioselective chemical reactions. In the biocatalysis reaction is used biocatalysts, that is in a cell or is from that cell isolated. The main thing is a chirality of aromas, that often occur in form of single enantiomers, which indicate differents sensorial marks in appearance of other regioisomers [Bednarski and Reps 2001; Serra and other 2005].

The most popular biocatalysts are lipases, that are easy available and active in organic solvents. The most popular microorganisms used in biocatalysis are bakery yeast, that enable e.g. enantioselective and diastereoselective reduction of γ-keto-acid. The homogenous enantiomers are initial material in production of (-)-cis i (+)-trans lactone whiskey and (+)-trans lactone cognac [Serra and other 2005].

The special role have methylotropic yeats like *Candida Boidinii, Hansenula sp., Pichia pastoris i Torulopsis methanothermo*, that catalise enantioselective oxidation of many 2-methyl-1-alcanols.

Aroma quality and his persistence have an important role by product choice. Inappropriate storage method leads to oxidation, hydrolyze, thermal degradation and other processes, that are causes of undesirable aroma changes [Jeleń 2004].

6. Summary

Bioaromas as a food additives are compounds of comestible product or its halfproducts. Their role base on the increasing food flavour sensation, therefore they are needful. In connection with derivation of aroma and its essential signification by cost calculating and by quality valuation of food products the optimal choice among aroma methods are biotechnological methods. Application of that method minimize use of chemical agent and price of bioaroma is lower with respect to extract aroma and many biotransformation methods enable a proper choice adequate to used microorganisms and to desirable aroma.

7. References

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