

Stability studies olihofruktozy and inulin and in drinks prepared from aromatic emulsions

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Abstract: *This article describes the use of emulsions for the production of beverages with inulin and oligofructose for for the restaurant business and industry. Inulin and oligofructose are high quality ingredients for the production of dietetic foods. Inulin and oligofructose can be used as a pure dietary ingredients to create functional foods with different stated properties, and as ingredients that improve the taste and texture and allows replacement of sugar and fat. The best results are obtained with a combination of dietary and technological concepts, which enables the development of high quality innovative food products.*

The work purpose – stability research inulin and olihofructose depend on pH size, temperature and a storage time of foodstuff in which they were used.

Keywords: *emulsion, drink, olihofructose, inulin, temperature, beverage storage, hydrolysis, pH*

I. Introduction

Emulsions are widely used in many branches of food technology. While using aromatic emulsions in functional beverages production a series of advantages is observed, in particular the blending time is decreased as there is no need to add aromatizer, to choose dye and stabilizer.

It is known that certain food additives that are used in the manufacture of food products can change their functional and other properties during storage and distribution.

Inulin and olihofructose can be used as dietary ingredients for the creation of functional foods with different properties, and as ingredients that improve the taste and texture that allows replacement of sugar and fat. The best results are obtained with a combination of dietary and technological concepts, which enables the development of high quality innovative food products [1].

There are two groups of inulin – native (standard), which have the same

structure and differ only by the properties of the particles, and which are derived from long-chain inulin standard by removing the low molecular weight fraction and which also differ from each other only by the properties of the particles.

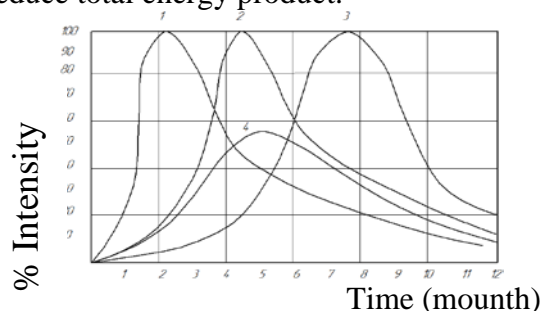
The main technological properties of inulin are:

- 1) Ability to replace fat in foods with the presence of the aqueous phase;
- 2) Ability to improve the taste of low-fat products, bringing them to the properties of normal fat content of products;
- 3) Ability to act as a texturing agent, emulsion stabilizer and thickener.

Olihofructose is a natural polysaccharide having the same molecule structure as inulin but shorter in length. Olihofructose is a natural component of natural inulin. Olihofructose produced by partial hydrolysis of inulin. This technology is also similar to the processes in the sugar and starch industry.

It is known that the solubility of olihofructose exceeds the solubility of sucrose, making it the soluble dietary fiber in the world. Olihofructose does not crystallize any precipitate and leaves the mouth dry and sandy taste. Olihofructose is not destroyed in the majority of high-temperature processes. Moderate reducing ability of olihofructose may lead to the formation of a weak brownish colour due to the reaction of melanoidin producing.

It has a neutral slightly sweet flavour, without foreign taste and aftertaste. Its sweetness profile is very similar to the profile of sweetness of sucrose (Pic 1). Therefore, the main technological feature is that it can replace sugar in various formulations, which allows not only to obtain foods low in sugar or sugar-free, but also to seek to reduce total energy product.



Pic. 1 Intensity profile:
1 – Acesulfame-K; 2-Saccharose; 3-Aspartame; 4-Olihofructose

Since olihofructose has little sweetness, it is usually used in combination with intense sweeteners or fructose. However, it masks the unpleasant aftertaste of intense sweeteners and sharp sweetness of fructose, improves taste and gives the food a mild, uniform taste.

Distinctive of olihofructose is its ability to show synergy with intense sweeteners, which allows you to reduce the dosage of these sweeteners while maintaining the desired level of sweetness. This effect, as well as the ability to

enhance the fruit flavour, is widely used in the manufacture of soft drinks.

It is known that in acidic medium and high temperature inulin and olihofructose can be hydrolysed to form shorter chains and fructose, resulting in partial or complete loss of their dietary properties, and, in some cases, to enhance sweetness of the finished product.

The problem of aroma and flavor stability is also solved because in such a case an emulsifier plays a role of aromatic part adsorbent and provides delicate and mild aroma.

The advanced technology of aromatic emulsions is associated with the peculiarities of hydrocolloids application. Constant attention to the research of these compounds is stipulated by their importance for the food industry. However, despite the large number of studies on the physical and chemical properties of hydrocolloids, there is insufficient scientifically based data on their use in food emulsions [2, 8, 9].

Emulsions are thermodynamically unstable. With time they tend to break down into their constituent oil and aqueous phases. The term 'emulsion stability' therefore refers to the ability of an emulsion to resist this breakdown, as indicated by growth in average size of droplets or change in their spatial distribution within the sample. The more slowly that these properties change, the more stable is the emulsion. In practice, stability is a relative term which depends on the context. For some food emulsions, such as cake batters or cooked sauces, the required time-scale for stability is only a few minutes or hours. But for other products, such as soft drinks and cream liqueurs, emulsion stability must be maintained over a period of several months or years [3,4].

A hydrocolloid ingredient may act as an emulsifying agent, as a stabilizing agent, or in both of these roles. An emulsifying agent (emulsifier) is a surface-active ingredient which adsorbs at the newly formed oil-water interface during emulsion preparation, and it protects the newly formed droplets against immediate coalescence. Given that polysaccharides are predominantly hydrophilic in molecular character, and most hydrocolloids are not surface-active, they cannot act as primary emulsifying agents. There is really only one hydrocolloid - namely, gum arabic - which is commonly employed as an emulsifying agent. The main emulsifying agents used in food processing are the proteins, especially those derived from milk or eggs. A stabilizing agent (stabilizer) is an ingredient that confers long-term stability on an emulsion, possibly by a mechanism involving adsorption, but not necessarily so. In O/W emulsions, the stabilizing action of hydrocolloids is traditionally attributed to the structuring, thickening and gelation of the aqueous continuous phase [4].

The functional role of these small-molecule emulsifiers in food technology is typically not for emulsion making, but for other reasons: controlling fat morphology and crystallization; promoting shelf-life through interaction with starch and gum arabic; and destabilizing emulsions by competitive protein displacement from the oil-water interface [4, 6].

A stable emulsion is one where the droplets remain sufficiently small and well separated that Brownian motion alone keeps them evenly dispersed throughout the continuous phase. The physico-chemical principles of O/W emulsion stability are based on the classical colloid theories of electrostatic and steric stabilization. Electrostatic stabilization arises from the presence of electrical charge on the surface of the droplets, or more usually on the

adsorbed stabilizer layer at the surface of the droplets. The greater the charge density at the surface, and the lower the ionic strength (electrolyte concentration) of the continuous phase, the more stable is the emulsion. Steric stabilization arises from the presence of a polymeric (steric) barrier at the droplet surface. To confer long-term stabilization, this polymer must be present at sufficient concentration to cover the oil-water interface completely, and it must remain permanently attached to the surface, with at least part of the molecule projecting away from the surface into the aqueous medium. Steric stabilization is increasingly supplemented by electrostatic stabilization in emulsions containing adsorbed proteins at pH values well away from the protein's isoelectric point (pI) [7].

Whether emulsion droplets will remain dispersed or will tend to stick together depends on the nature of the antiparticle pair potential between the droplet surfaces. Generally speaking, colloidal stability requires that the antiparticle repulsion should be of sufficient range and strength to overcome the combined effects of gravity, convection. Brownian motion and the ubiquitous short-range attractive forces together drive the system towards its final and inevitable phase-separated equilibrium condition (**Fig. 1**).

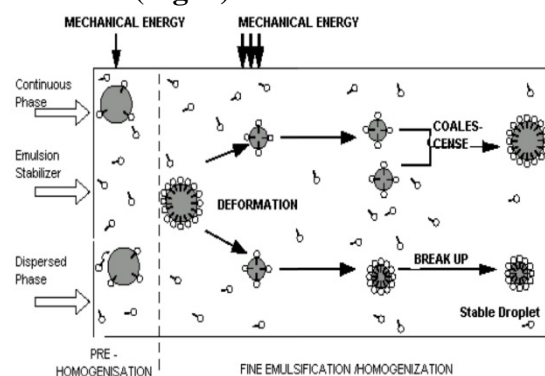


Fig. 1 Emulsification and stabilization

The aim is to study particle size effects on the stability of emulsions during storage and use in the manufacture of beverages and their stability during 180 days [5, 8].

II. Materials and methods

A stability study of inulin and oligofructose in the drinks was conducted according to standard laboratory methods: varying the acidity of the drink, changed the pH, the temperature changes by heating, and storage time - by putting a drink on the resistance. Using standard laboratory equipment: pH meter, saccharimeter and thermometer [8, 9].

The soft drink with dry matter content 10.0% have been used as the object of studies in beverages alter the pH value of the medium, temperature and holding time. We studied the effect of pH and temperature on the degree of hydrolysis of olihofructose. Samples were prepared beverage containing olihofructose 20% and 40%. Results are presented in Table 1 and 2.

The pH and temperature effect dependence in olihofructose hydrolysis degree (the beverage 20% content).

Table 1

Temperature, ° C	Machining time, min	Degree of hydrolysis olihofructose at different pH values,%		
		pH = 6.0	pH = 4.0	pH = 3.5
85,0	2,0	0	<1,0	5,0
85,0	5,0	0	<1,0	6,0
90,0	5,0	0	<1,0	10,0
95,0	2,0	0	1,0	10,0
95,0	5,0	0	1,0	16,0

From the data table shows that the pH equal to or above 4.0 the hydrolysis occur slightly at all temperatures. While reducing the pH becomes more critical. Thus, at pH 3.5 and 95 ° C for 5 min is 16% hydrolysis.

The same trend is observed in beverages containing 40% olihofructose. The data are presented in Table 2.

The dependence of the effect of pH and temperature on the degree of hydrolysis

olihofructose (the content of the beverage 20%)

Table2

Temperature, ° C	Machining time, min	Degree of hydrolysis olihofructose at different pH values,%		
		pH = 6.0	pH = 4.0	pH = 3.5
85,0	2,0	0	< 1,0	4,0
85,0	5,0	0	<2,0	5,0
90,0	5,0	0	<2,0	9,0
95,0	2,0	0	<2,0	10,0
95,0	5,0	0	<2,0	15,0

Further investigate the influence of pH and temperature on the degree of hydrolysis of inulin. We prepared alcoholic beverages containing 10% inulin. Results are presented in Table 3

The pH and temperature effect dependence on the degree of hydrolysis of inulin (the content of the beverage 20%) [10, 11].

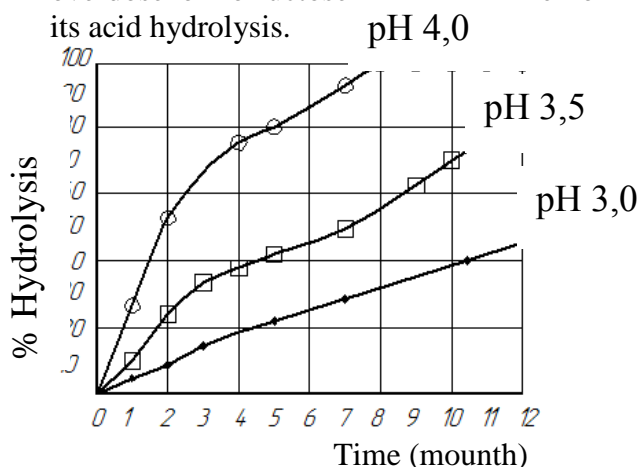
Table 3

Temperature, ° C	Machining time, min	Degree of hydrolysis of inulin at different pH values,%			
		pH = 6.5	pH = 4.0	pH = 3.5	pH = 3.0
70,0	5,0	0	<1,0	<1,5	1,0
	15,0	0	<1,0	<1,5	5,0
	30,0	0	<1,0	<2,0	7,0
	60,0	0	<2,0	<2,5	13,0
90,0	5,0	0	<2,0	<3,0	17,0

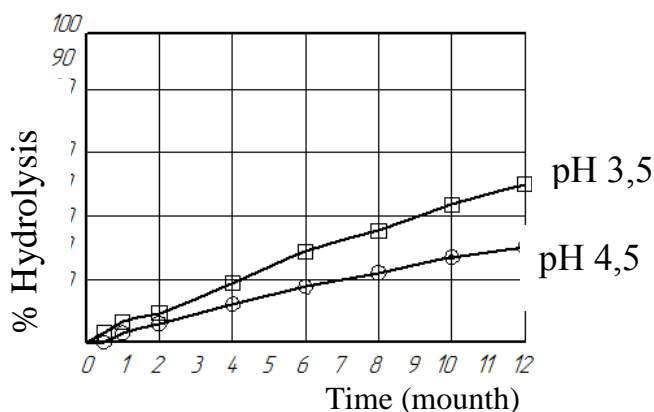
From the data table shows the effect of pH and temperature on the degree of hydrolysis of inulin. If the pH is higher or equal to 4.0, the total hydrolysis at all temperatures low. At lower pH, the temperature is an important parameter. Thus, at 70 ° C for 60 min is 13%, at 90 ° C in 17%.

Later the stability has been established of inulin and olihofructose in storage drinks. For this purpose, we used non-alcoholic beverages containing 10% dry matter and various dosages of olihofructose and inulin. Results are presented in Pic. 2 and 3.

Pic 2 shows that the degree of hydrolysis of olihofructose can be quite high in beverages with pH 4.0 and a shelf life of up to 6 months to produce 20% probability overdose olihofructose to compensate for its acid hydrolysis.



Pic. 2 Hydrolysis olihofructose during storage for 12 months at 20 ° C and different values in pH



Pic. 3 Hydrolysis inulin during storage for 12 months at 20 ° C and different values in pH

Pic 3 shows the change in the degree of hydrolysis of inulin during storage of non-

alcoholic beverages for 12 months at 20 ° C.

It follows that inulin is more suitable as an ingredient, such as fiber and acid drinks with long shelf life. Thus, pH 4.0 hydrolysis after 6 months of storage does not exceed 15%, which can be easily compensated 15% overdose of inulin. This ensures consumers claimed dietary fiber content for the duration of life. Hydrolysis products do not cause changes in taste due to a low enough concentration of inulin, no more than 2% of the recommended for this application.

On the basis of these studies found that the degree of hydrolysis of olihofructose at different temperatures and pH, changes with different intensities.

III. Results and discussion

Thus, at a pH equal to or above 4.0 and a temperature of 85-90 ° C, the hydrolysis of olihofructose is low. In the case where the pH is reduced, and the temperature rises, the hydrolysis process is increasing dramatically. Thus, at pH 3.5 and 95 ° C the degree of hydrolysis of the olihofructose in the product increased by about three times.

V. Conclusions

The use of aromatic emulsions in the manufacture of functional drinks has several benefits, including: reduced duration blending, as there is no need to pick up the flavor, color and taste.

In the study of the degree of hydrolysis of inulin at 70-90 ° C in an acidic environment, it was found that at pH = 4.0 and above, hydrolysis is negligible. However, with a decrease in pH and the temperature rises to 95 ° C, the hydrolysis of inulin increased approximately two-fold. In addition, slight with increase in

sweetness of the finished product without degrading its consumer properties have been showed.

The process of storing drinks not observed the emergence of oil rings on the surface of the drink, there was no change in color, taste and aroma of the drink. Drinks made with the addition of gum arabic emulsions have better storage stability compared with a drink on starch (Fig. 2).

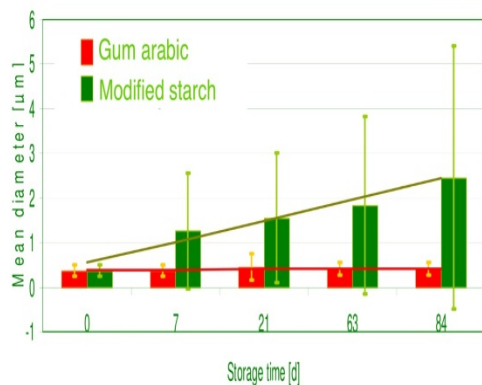


Fig. 2 Emulsion – long-term stability

Complete the emulsion must have the following parameters: the size of the oil particles (up to a micron); organoleptic - appearance, color, smell (aroma) and taste according to recipes; density (1,030-1,100), g/cm³; pH (3, 3 ± 0, 7); stability in the drinks.

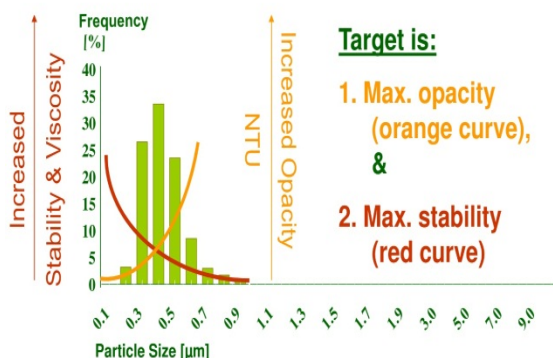


Fig. 3 Emulsion summary

The best result of research in emulsions - is to obtain the maximum number of particles of about 1 micron (Fig. 3).

Creating a stable emulsion system is a pressing issue in the food industry, so these studies are useful and important for the development of new food products.

References

- [1]. PHILLIPS G.O., WILLIAMS P.A., (Eds.) Handbook of Hydrocolloids. Cambridge: Wood Head Publishing, 156 c, (2000).
- [2]. Nelson, DL & Cox, M. (ed.) Book principled biochemistry
- [3]. McKENNA B.M. (Ed.), Texture in Food — Vol. 1: Semi-Solid Foods. — Cambridge: Woodhead Publishing, 480 c, (2003).
- [4]. BOGACH A., Aromatic emulsion for manufacture of soft drinks, *Food & Drinks. Food & Beverage*, 4 - S. 10-11, (2003).
- [5]. STEPHEN P., U.S. Patent for invention № 6576285, Cholesterol lowering beverage, Bader, Fowler, 10.06.2003.
- [6]. IMESONA. (Ed.), Thickening and Gelling Agents for Food. 2nd Ed., London: Blackie Academic and Professional, 408 c, (1999). 1. <http://arhiv-stately.pp.ua>
- [7]. Gallagher, D., Stallings, W., Blessing, L., Buster, F. & Brady, L. (1996) Probiotics, cercal micro flora and aberrant crypts in the rat colon. *J. Nitre*. 126:1362-1371
- [8]. Mezler D. E. Manual in Biochemistry. Chemical reactions of living cells.
- [9]. Belval, H. (1927) Industrie Inulin and levulose. Ten Years of Efforts Scientific, Industrial and Colonial 1914-1924 :1068-1069. Chemistry and Industry Paris, France.
- [10]. Berninger, A., Wenger, R. (1995) Inulin in the diet of the diabetic. *Doetsch. Z. digestive Stofwechselkrankh* 15:268-272.
- [11]. Fiordaliso M., Kok N., Desager J., Goethals F., Deboyser D., Roberfroid M. & Delzenne, N. (1995) Dietary oligofructose lowers triglycerides, phospholipids and cholesterol in serum and very low density lipoproteins in rats. *Lipids* 30:163-167.