Physico-chemical properties of commercial pectin powders

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Abstract: By consuming fruits and vegetables in our daily diet we eat pectin. Pectin represents the polysaccharides present in plant cell walls all around us. They are probably the most complex macromolecules in nature, as it can be composed out of as many as 17 different monosacharides. Pectin is used as a thickening and gelling agent in a wide range of foods and soft drinks. In most pectin applications there are a lot of condition in the product formulation like pH, ionic strength and composition, the proportion of sweeteners and their nature, which affect the pectin.

Key words: pectin, polysaccharides, physic-chemical parameters, high methyl ester pectin, low methyl ester pectin

INTRODUCTION

Food consumers expect that food should be convenient to prepare, tasty, safe, healthy and should have a good shelf life. Moreover, more and more consumers leave many aspects of the preparation of daily meals to the food industry. This creates an increasing demand for functional ingredients whit superior properties in the production of foods – and “designer” pectins are expected to play an important role in this future (Willats et. al., 2006). Pectin is a high value functional food ingredient widely used as a gelling agent and stabilizer. For use in food is defined as a polymer containing galacturonic acid units (at least 65%). The acid groups may either be free, combined as a methyl ester, or as sodium, potassium, calcium or ammonium salts, and in some pectins amide groups may also be present (Ensymm UG&Co.KG). It is produced commercially in form of white to light brown powder, mainly extracted from citrus fruits, and is used in fillings, sweets, as a stabilizer in fruit juices and milk drinks and as a source of dietary fiber (May C.D, 1990). Pectin is present not only in the primary cell walls but also in the middle lamella between plant cells where it helps to bind the cells together. The amount, structure and chemical composition of the pectin differs between plants, within a plant over time and in different parts of a single plant (Srivastava and Malviya, 2011). Because the ability of pectins to form gel depends on the molecular size and degree of esterification (DE), the pectin from different sources does not have the same gelling ability due to variations in these parameters. Therefore, detection of a large quantity of pectin in a fruit alone is not in itself enough to qualify that fruit as a source of commercial pectin (Thakur et al., 1997). Pectin as extracted normally has more than 50% of the acid units esterified, and is classified as high methyl ester pecton or HM pectin. The percentage of ester groups is called degree of esterification. High methyl ester pectins are classified in groups according to their gelling temperature as rapid set to slow set pectins. Modification of extraction process, or continued acid treatment, will yield a low methyl ester pectin or LM pectin with less than 50% methyl ester groups (Ensymm UG&Co.KG).

MATERIAL AND METHODS

Commercial pectins are almost exclusively derived from citrus peel or apple pomace, both by-products from juice (or cider) manufacturing. Apple pomace contains 10-15% of pectin on a dry matter basis. Citrus peel contains of 20-30% (May C.D., 1990). We've decided to analyze different types of pectin besides the usual ones, to observe the differences between the raw material and the caracteristics in different food or beverage products. High-methylester pectin is distinquished from low-methylester pectin by their different ability to form gels for different application areas. We had 2 different types of commercial lemon pectin, strawberry, pineapple and carrot. For those samples we have determinated the density using an electronic densimeter, moisture content by Karl Fischer titration method, titrable acidity as citric acid monohydrate, ash at 550°C for 2 hours, total carbohydrates, glucose, fructose, sucrose and protein.

RESULTS AND DISCUTION

The most important commercial application of pectin is gelation. Under certain conditions pectin forms a three-dimensional network, which is stabilized by interactions between pectin molecules. For initiating the gelation process a minimum concentration of the pectin is necessary. Important factors influencing the gelation process and pectin concentration needed to set are molecular structure of pectin, concentration and type of total soluble solids, pH value, ionic strength, valency and kind of ions, and temperature in the manufacturing process.

The physico-chemical parameters of the pectins analyzed are show in the tables bellow.

I. Lemon pectin Ingredients [%]: fruit solids 10; added sucrose 83; added citric acid 1; added fructose 6.			
Density [g/cm^3]	0,5	Total carbohydrates [%]	90
Moisture [%]	2,3	Glucose [%]	3,8
Ash [%]	0,3	Fructose [%]	5
Titrable acidity [%]	7,3	Sucrose [%]	81
		Protein [%]	0.2

II. Lemon pectin Ingredients [%]: fruit solids 50; added maltodextrin 50.			
Density [g/cm^3]	0,5	Total carbohydrates [%]	55
Moisture [%]	3	Glucose [%]	13
Ash [%]	1,2	Fructose [%]	7
Titrable acidity [%]	28	Sucrose [%]	1,2
		Protein [%]	0.9

I. Strawberry pectin Ingredients [%]: fruit solids 10; added sucrose 80; added citric acid 0,2; added fructose 9,8.			
Density [g/cm^3]	0,7	Total carbohydrates [%]	95
Moisture [%]	2,1	Glucose [%]	3,1
Ash [%]	0,5	Fructose [%]	11,5
Titrable acidity [%]	2	Sucrose [%]	78
		Protein [%]	0.4

II. Strawberry pectin Ingredients [%]: fruit solids 50; added maltodextrin 50.			
Density [g/cm^3]	0,6	Total carbohydrates [%]	73
Moisture [%]	2,8	Glucose [%]	13
Ash [%]	2,8	Fructose [%]	15
Titrable acidity [%]	6,8	Sucrose [%]	4,8
		Protein [%]	1,8

I. Pineapple pectin Ingredients [%]: fruit solids 100.			
Density [g/cm^3]	0,6	Total carbohydrates [%]	82
Moisture [%]	1,8	Glucose [%]	30
Ash [%]	3,2	Fructose [%]	28
Titrable acidity [%]	10,3	Sucrose [%]	31
		Protein [%]	2,9

II. Pineapple pectin Ingredients [%]: fruit solids 40; added sucrose 60.			
Density [g/cm^3]	0,7	Total carbohydrates [%]	91
Moisture [%]	2,2	Glucose [%]	15
Ash [%]	1,5	Fructose [%]	12
Titrable acidity [%]	1,9	Sucrose [%]	66
		Protein [%]	0,9

I. Carrot pectin Ingredients [%]: fruit solids 100.			
Density [g/cm^3]	0,4	Total carbohydrates [%]	77
Moisture [%]	2,2	Glucose [%]	15
Ash [%]	7,5	Fructose [%]	18
Titrable acidity [%]	1,2	Sucrose [%]	28,5
		Protein [%]	11

II. Carrot pectin Ingredients [%]: fruit solids 39; added sucrose 39; added native corn starch: 22.			
Density [g/cm^3]	0,5	Total carbohydrates [%]	85
Moisture [%]	4,3	Glucose [%]	6
Ash [%]	2,8	Fructose [%]	4
Titrable acidity [%]	0,6	Sucrose [%]	40,5
		Protein [%]	2,3

Hight-methylester pectin form gels at total soluble solids higher than 55% and pH values below pH 3.5. Junction zones stabilizing the gel structure are forms by hydrophobic interactions between methylester groups and hydrogen bonds between hydroxyl groups. Therefore high-methylester pectins are used as gelling agent for traditional jams, jellies and marmalades.

Low-methylester pectin is able to form gels relatively independent from the content of total soluble solids content and pH value by forming junction zones under the influence of divalent metal ions. Low-methylester pectins may find enough ions to establish firm junction zones already present, or ions, for example calcium, are added separately to the system. The calcium content influences the gel strength formed (Sungsoo Cho and Samulel, 2009)

CONCLUSIONS

Pectin is generally regarded as one of the safest and most acceptable of food additives. In all pectin application, the action of the pectin is very dependent on the exact conditions in the product, pH, ionic strength and composition, the proportion of sweeteners and their nature, and, where fruit is present, the amount and nature of the pectin provided by the fruit. It is therefore always wise to test any change in formulation on a small scale before embarking on full scale manufacture (May, 2000).

The most important property of pectin it is the ability to gel under the appropriate conditions. High methoxyl pectins need a minimum of 60% soluble solids and a pH between 2,8 and 3,6 to gel. On the other hand low methoxyl pectins need a controlled amount of calcium ions to gel. The dosage of pectin depends on the recipe and the application. The dispersion and solubility process are very important. Pectin dissolves slowly in cold water so that solution should usually be brought to a boil. There can be a few errors in the process. If gelation is too weak or absent there can be different causes like: pH value is too high, calcium dosage too low for low nethoxyl pectin, solids content too low, pectin is not completely dissolved or it was used a unsuitable pectin type. If the gelation is too strong there can be considered pH value too low as a cause. Beside that solids content too high or pectin quantity too high can also cause a too strong gelation.

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