EXAMINATION OF PHISICAL PARAMETERS OF PECTIN GELS EXTRACTED FROM FRUIT PRESSCAKES

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ABSTRACT

In our study we aimed to investigate the rheological and colour characteristics of the pectin gels extracted from presscakes of berries. The pectins extracted from the presscakes of five different fruits such as black-currant, red-currant, raspberry, blackberry and elderberry, were used for the examinations. Two commercial materials were applied as controls: apple and citrus pectins. The rheological examinations showed that the pectins obtained from the red-currant presscake have the best gelificator properties. The analysis of the colour coordinates revealed that the gel of the citrus pectin used as control is very clear and translucent such as the pectin gel of the red-currant. The pectin gels of black-currant, blackberry, elderberry and raspberry contain a significant amount of colourants, in this way they are very dark.

1. INTRODUCTION

The presscake obtained by pressing fruit juices in the traditional process increases the quantity of technological waste. Generally it's further used as forage compound or compost. However in case of the aforementioned exploitation the useful substances that remain in the presscake after pressing get wasted, such as pectin, minerals, vitamins, colorants for the berries. Pectin is used in food-industry as gelificator, volume expander as well as stabilizer. The presscake or rape resultant from berries, contains important quantities of pectin, which is worth to be extracted, and whose characteristics deserve further examination.

In our study we aimed to examine the rheological and color characteristics of pectin gels extracted from berries, and to compare them with the corresponding values of commercial apple and citrus pectins.

2. MATERIALS AND METHODS

The pectins extracted from the presscakes of four different berries were used during the examinations, namely: black-currant, red-currant, raspberry and elderberry. Two commercial materials were applied as controls: apple and citrus pectins.

Rheological analysis

For the examinations a gel was prepared from each pectin the following way:
150 ml water+ 5g pectin+ 60g sugar+ citric acid (pH:3.5) to adjust the pH, heating up to the boiling point applying continuous stirring, then cool to 20°C.
The analysis was carried out using a RHEOTEST 2 rotational viscometer thermostated at 20°C. S1 plate was used for red-currant, raspberry elderberry and apple pectin gels, and H plate for citrus and red-currant pectin gels.

The shearing stress (τ) were determined in the 0,166-145,8 1/s speed gradient (D) range. The apparent viscosities were calculated by the $\eta=\tau/D$ equation with the same speed gradient.

The colour analysis

The colour of the pectin powders and gels were characterized by the CIE L*a* b* colour coordinates determined by a Hunter MiniScan spectrofotometric colour analyzer. The software of the instrument determined the colour coordinates from the reflection spectrum of the gels, recorded in the wavelength range of 400-700 nm, applying 1cm thick layer of 20°C gel poured in an optical glass measuring jar, using white background. For the analysis of the powders the same jar was used, filled 1 cm high.

3. RESULTS AND DISCUSSION

Results of rheological analysis

The flow curves (the shear stress in function of the speed gradient) of the pectins obtained from the press-cakes and the commercial control apple and citrus pectins are represented together (Fig. 1). τ(Pa) indicates the shear stress and D(1/s) the speed gradient.

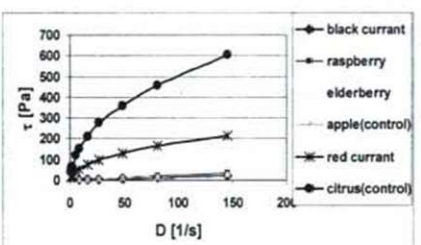

Figure 1. Flow -curves of control pectin gels and pectin gels prepared from fruit presscakes

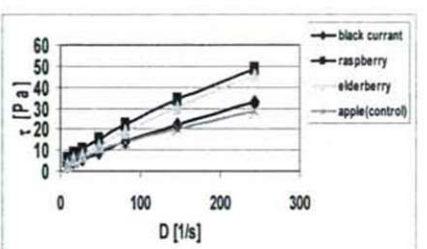

Figure 2. Flow-curves of apple pectin gel and pectin gels prepared from fruit presscakes

The form of the flow curves show that the gels of the control citrus pectin and the pectin obtained from the red-currant presscake behave as general Newtonian fluids, their rheological description can be given by the Ostwald-equation $\tau = K \cdot D^n$, where K and n are constants. The value of n is the flow index that shows the deviation from the linear . The variation of the flow index indicates the variation of the apparent viscosity. Fig. 1 shows also that the flow characteristics of the control citrus pectin gel are substantially different from those of the other pectins, it's less liquid and much more resistant for the same speed gradient. Only the pectin gel of the red-currant presscake has similar consistence.

In Fig. 2 we can compare the flow-curves of the more liquid pectin gels prepared from the presscakes of raspberry, black-currant, elderberry, and the control apple pectin gel.

The figure shows that the pectin gels of black-currant, raspberry, elderberry and apple can be considered as Newtonian fluids by their flow-curves, and have similar flow-characteristics. The apparent viscosity values calculated for a given speed gradient are presented in Fig. 3 to compare the consistence of the different pectin gels. The viscosity was calculated for a speed gradient (D) of 143 1/s applying the $\eta = \frac{\tau}{D}$ relation.

The results represented in Fig. 3 demonstrate that the citrus pectin gel and the pectin gel obtained form the red-currant presscake have 25-30 time higher viscosity values than the other studied pectin gels. The consistence of the red-currant pectin gel is similar to that of the control citrus pectin.
The mean apparent viscosities of the less viscous pectin gels with the smallest significant difference are shown in Fig. 4 together with the also little viscous apple pectin gel, used as second control.

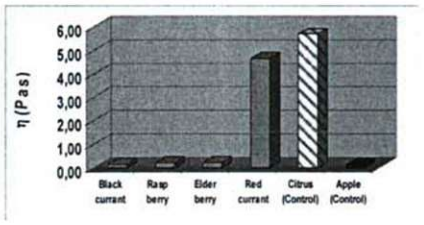

Figure 3. Viscosity of control pectin gels and pectin gels prepared from fruit presscakes

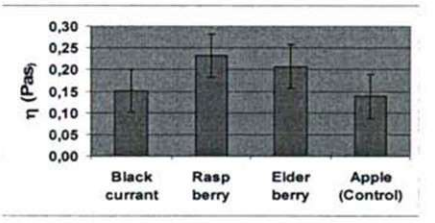

Figure 4. Viscosity of apple pectin gel and pectin gels extracted from fruit presscakes

The results presented in Fig. 4 and those of the variance analysis show that there's no significant difference in the consistence of the control apple pectin gel and that of the pectin gels obtained from black-currant, raspberry and elderberry presscakes.

Results of colour measurements

Colour characteristics of pectin powders
From the CIE L*a*b* colour coordinates of the apple pectin powder and the pectin powders obtained from the presscakes by the $C^* = \sqrt{a^{*2} + b^{*2}}$ relation we determined the chroma value, that represents the colour-saturation. The L* (lightness) and corresponding C* (chroma) values are presented in the L*-C* colour plane to compare the colour of the powders.

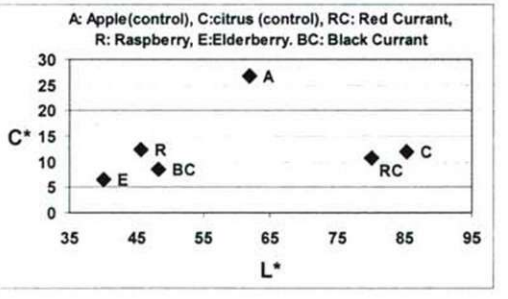

Figure 5. Colour saturation and lightness values of pectin powders

As Fig 5 shows that the powder of the control citrus pectin is the clearest and has low chroma value. The colour of the pectin powder extracted from the red-currant presscake is similar, only 3 colour units darker. Whereas the second control apple pectin is substantially

darker and colourful. There is a difference of 25 colour units. The pectin powders extracted from the presscakes of elderberry, raspberry and black-currant are approximately 40 colour-units darker then the citrus and red-currant pectins. The low lightness factor together with the low chroma value characterizes the dark-grey colour.
We can conclude that from the red-currant presscake we succeeded to produce a pectin powder alike to the control citrus pectin also regarding the colour.

Colour characteristics of pectin gels
The L* and C* colour coordinates are presented in the L* -C* colour plane to compare the colour of the different pectin gels (Fig 6.).
It can be observed that the position of the colour points correspond to the results obtained in the powder form. The most transparent is the citrus pectin gel, the clearness value of 50 results from the strong light reflection from the white background placed behind the pectin gel layer. In the case of the red-currant pectin gel slightly less light is reflected by the white background.

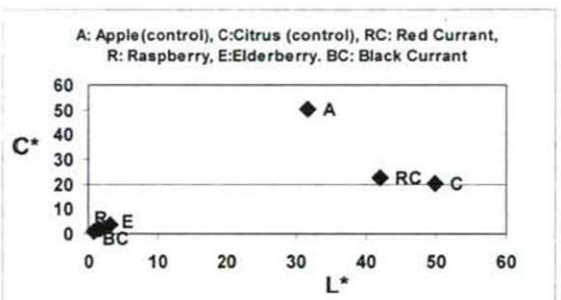

Figure 6. Colour saturation and lightness values of pectin gels

The apple pectin gel, choosed as second control is of relatively high chroma and nearly 20 units darker than the citrus pectin gel. Due to the great amount of colorants, the elderberry-, raspberry- and black-currant pectin gels are almost black. They are 40 units darker and their chroma value is below 5 units.

4. CONCLUSION

We can conclude that the gelifying properties of the pectins obtained form different raw materials can be compared and categorized by analysing their flow-curves, determined by a rotational viscometer, and the calculated apparent viscosity values.
By instrumental color measurement it is confirmed that the colour of the pectins and their gels obtained from different raw materials changes in a wide range depending on the type and quantity of the colourants remaining with the pectin.

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