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Taste- and Flavour-Quenching of Horseradish by Hydrocolloids

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Abstract: The intended aim of this study was to investigate the influence of different hydrocolloids on the pungency of horseradish. The utilized hydrocolloids were alginate, gellan gum and agar, each hydrocolloid was used in different concentrations. Horseradish-hydrocolloid-mixtures were prepared and tested by a taste panel. In general, the panelists got several samples of these horseradish-hydrocolloid-mixtures to order them in an increasing ranking according to pungency. The results show some distinctions in the effect of masking: Using alginate, the pungency of horseradish decreases right from the beginning continuously whereas the masking effect of gellan gum as well as agar started not before 2%.

Keywords: Agar, alginate, gellan gum, masking, pungency

INTRODUCTION

Today hydrocolloids play an important role in many food formulations and are essential for industrial food production. Benefits of hydrocolloids are their simple application and their effectiveness in rising up desired viscosities and water binding. Dispersed in water they are able to form viscous dispersions or gels. The mechanism of this essential function is based on the presence of many hydroxyl groups which increase the hydrocolloids' affinity for binding water molecules. This characteristic is common to all hydrocolloids. Hydrocolloids form a heterogeneous group and hold a large spectrum of functional properties in foods. According to their main uses thickening and gelling, the large group of hydrocolloids is divided into two subcategories: the thickening and the gelling agents (Saha and Bhattacharya, 2010).

Although hydrocolloids provide beneficial properties for food technology, they involve a problem. It is often mentioned that the use of hydrocolloids leads to masking taste and flavour of the food (Guichard *et al*., 1991; Izutsu and Wani, 1984; Marshall and Vaisey, 1972; Pangborn and Szcezesniak, 1974; Pangborn *et al*., 1973; Vaisey *et al*., 1969).

This quenching of aroma components represents a challenge in food processing in order to avoid a suffering taste from higher viscosity. Many studies dealing with this subject focus on the basic tastes: sourness, saltiness, bitterness and especially sweetness. Instead of those studies, the present study concentrates on a different taste: the pungency of horseradish.

The root of horseradish is used as vegetable and pungent spice. It contains many volatile constituents, e.g., methyl-, ethyl-, isopropyl-, 2-butyl-, allyl-, 4-pentenyl- and 2-phenethyl-isothiocyanate and allyl thiocyanate. The principle pungent compounds of horseradish are the allyl- and 2-phenethyl-isothiocyanate (Gilbert and Nursten, 1972). In consequence of the influence of heat, the hot tasting constituents are degraded (Sahasrabudhe and Mullin, 1980).

According to the existing studies and scientific results, it is hypothesized that the pungency of horseradish is differently quenched by hydrocolloids. The target of the present study is to show the influence of different hydrocolloids on the pungency of horseradish. In particular, it is focused on tests with alginate, gellan gum and agar which will be used in different concentrations.

MATERIALS AND METHODS

The study was conducted at the department of "Technology of Plant Derived Food" at the University of Applied Sciences in Fulda (Germany) from October 2011 to January 2012.

Seven days of practical work were scheduled for sensory tasting. Before the horseradish-hydrocolloid-mixtures were prepared, the horseradish raw material used for the new test series was compared to the horseradish used for the last test series regarding its pungency, color and general taste.

Preparation of horseradish-hydrocolloid-mixtures: Table 1 shows the different hydrocolloids and concentrations which were used in the present study. The highest producible concentrations of the hydrocolloids are 4% of alginate, 15% of gellan gum and 10% of agar.

The three different horseradish-hydrocolloid-mixtures (200 g each) were prepared as follows:

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Table 1: Concentrations of alginate, gellan gum and agar in the horseradish-hydrocolloid-mixtures

Hydrocolloid	Concentration of hydrocolloid (%)
Alginate	0.5
	1.0
	1.5
	4.0
Gellan gum	2.0
	5.0
	10.0
	15.0
Agar	2.0
	5.0
	10.0

Alginate (sodium alginate; Tate and Lyle Food Systems) or gellan gum (CEROGA Gellan 700; C.E. Roeper GmbH) were dispersed in a mixture of horseradish (Bayerischer Meerrettich scharf und würzig; Schamel Baiersdorf; batch: L 310007284) and room temperature tap water with a blender shaft (Robert Bosch Hausgeräte GmbH; Model: MSM 6280/03 FD: 9104) for 30 sec. Then the material on the vessel wall was scraped and dispersed for 30 sec again.

Agar (Tate and Lyle Food Systems) was blended with the blender shaft into tap water of 85°C according to Scherz (1996) for 30 sec. The mixture cooled down to 40°C.

Evaporated water was added to horseradish and mixed with the agar-mixture. The mixture was homogenized with the blender shaft for further 60 sec. All mixtures were filled in preserving jars and stored in the fridge for 1 h. The horseradish used for all tests was taken from the same batch.

Panel training: The new recruited panel consisted of six male and three female students and university employees. The tasting room was a quiet, separate room but did not correlate to the DIN EN ISO 8589 (2010). During training, the nine panelists got four different horseradish-water-solutions which consisted of 0, 10, 25 and 50% horseradish, respectively. The different concentrations were judged by their pungency according to a scale where 50% horseradish-water-solution had a pungency of 3 while a 0% solution had a pungency of 0.

The horseradish-water-solutions were prepared in the following way. Horseradish was mixed with tap water of room temperature for 60 sec by a blender shaft. After preparation, the solutions were stored in preserving jars until the tasting samples were prepared. Every solution was filled in a jar which was provided with the associated pungency value. The samples were handed from the lowest to the highest pungency. Before training starts, all panelists should neutralize their mouth with tap water. Every sample must be homogenized with a spoon before tasting and should be swallowed. White bread, tap water and peppermint oil were handed as neutralization media.

Target of the training was that panelists were aware of pungency increase from sample to sample. The training was conducted twice.

Sensory testing: The following test was a ranking-test (DIN ISO 8587, 2010). Here the samples should be ordered from the lowest to the highest pungency. Every panelist got five coded jars in randomized order with the different concentrations of one hydrocolloid. Every time, one of these samples was the 50% horseradish-water-solution without hydrocolloid. Regarding agar, panelists got in the first tasting two samples of the same hydrocolloid concentration (2%) and in the second tasting two samples of the same hydrocolloid concentration (5%). Alginate and gellan gum did not have two samples of equal hydrocolloid concentration. All tastings were conducted twice. The used neutralization media were the same as in the panel training. Before tasting, the panelists were asked to ignore the viscosity of the different samples.

Sensory evaluation: The statistical evaluation of the test results was ensued by rang-sum-treatment (DIN ISO 8587, 2010). In order to prove an effect of pungency distinctions of the different horseradish-hydrocolloid-mixtures of alginate, gellan gum and agar, test for dependent samples and paired comparison test by Friedman (DIN ISO 8587, 2010) were used. The significance level was determined up to $\alpha = 1\%$ for all ranking-tests. Furthermore, the Page-test was conducted in order to investigate a disproof of the null hypothesis (DIN ISO 8587, 2010).

RESULTS AND DISCUSSION

Relationship between horseradish pungency and different hydrocolloids: For ranking-tests, horseradish was mixed with different amounts of hydrocolloids.

Figure 1 shows the quenching effect of each horseradish-hydrocolloid-mixture evaluated by the panel. The curves present the means of two determinations for each hydrocolloid and show the associated standard deviations. To ensure the comparability between the single ranking-tests, a normalization of pungency values was conducted. To this end, the 50% horseradish-water-solution was always defined as the highest pungency value of 5 on the y-axis. The panelists were not aware that the 50% horseradish-water-solution was the most pungent sample in order to avoid any influences on the results.

Alginate reduces the pungency immediately whereas gellan gum and agar start quenching not before a hydrocolloid-concentration of 2%. The pungency of gellan gum and agar did not decrease until 2% of hydrocolloid-concentration while the pungency of horseradish in alginate already decreased at 0.5%.

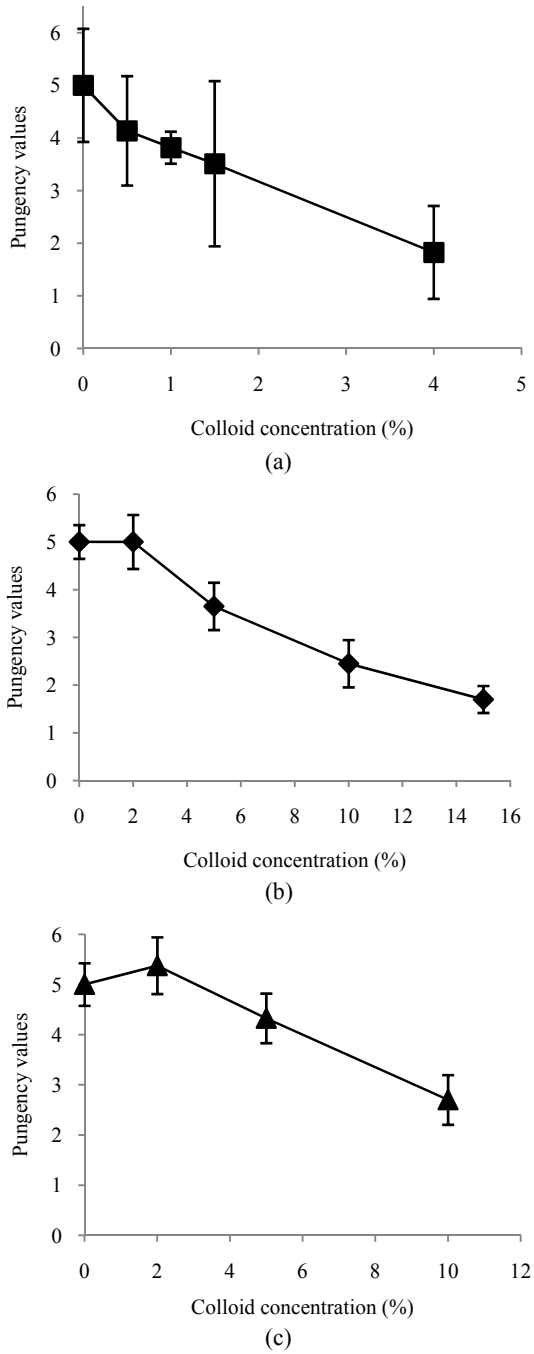

Fig. 1: Quenching effect as a function of the hydrocolloid concentration: (a) horseradish with alginate, (b) horseradish with gellan gum, (c) horseradish with agar

In addition, each of the three charts indicated that the pungency of horseradish is reduced by rising amounts of hydrocolloids.

Every hydrocolloid-concentration, which was used to prepare a horseradish-hydrocolloid-mixture, was tested by the panel twice. In general, the curves of the double determinations did not show considerable differences. Only tests with alginate offered standard deviations greater than 1.0. Ranking-tests with gellan gum and agar made up standard deviations in the range of 0.2 to 0.8 as shown in Fig. 1.

A lot of studies report on a reduced intensity of odour, taste and flavour in food containing hydrocolloids but none compared the different hydrocolloids with each other regarding the pungency of horseradish as done here. The masking effect seems to depend on the variety of hydrocolloid as well as the concentration which were used. Pangborn *et al*. (1973) mentioned taste suppression caused by hydrocolloids already in the year 1973. Similar studies have followed and draw the same conclusion that the use of hydrocolloids in food systems reduces tasting properties (Pangborn and Szcezesniak, 1974; Izutsu and Wani, 1984; Guichard *et al*., 1991; Marshall and Vaisey, 1972). Vaisey *et al*. (1969) assumed that the masking effect would be stronger the slimier the hydrocolloid sol is whereas it will occur to a lesser extent if the hydrocolloid offers more shear-thinning in the mouth.

The quenching effect could be explained by the viscosity increasing property. It is supposed that the hydrogen bonded systems of the hydrocolloids involve the taste and flavour units so that they will be less accessible to the tongue (Marshall and Vaisey, 1972).

In summary it can be said that horseradish was less pungent with increasing hydrocolloid-concentration. Surprisingly, alginate quenches the pungency immediately whereas in case of agar and gellan gum the quenching effect starts not before a hydrocolloid-concentration of 2%.

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REFERENCES

DIN EN ISO 8589, 2010. Sensory Analysis - General Guidance for the Design of Test Rooms (German). Beuth Verlag, Berlin.

DIN ISO 8587, 2010. Sensory Analysis-Methodology-Ranking, (German). Beuth Verlag, Berlin.

Gilbert, J. and H.E. Nursten, 1972. Volatile constituents of horseradish roots. J. Sci. Food. Agr., 23: 527-539.

Guichard, E., S. Issanchou, A. Descourvieres and P. Etievant, 1991. Pectin concentration, molecular weight and degree of esterification: Influence on volatile composition and sensory characteristics of strawberry jam. J. Food Sci., 56: 1621-1627.

Izutsu, T. and K. Wani, 1984. Food texture and taste: A review. J. Texture Stud., 16: 1-28.

Marshall, S.G. and M. Vaisey, 1972. Sweetness perception in relation to some textural characteristics of hydrocolloid gels. J. Texture Stud., 3: 173-185.

Pangborn, R.M., I.M. Trabue and A.S. Szcezesniak, 1973. Effect of hydrocolloids on oral viscosity and basic taste intensities. J. Texture Stud., 4: 224-241.

Pangborn, R.M. and A.S. Szcezesniak, 1974. Effect of hydrocolloids and viscosity on flavor and odor intensities of aromatic flavor compounds. J. Texture Stud., 4: 467-482.

Saha, D. and S. Bhattacharya, 2010. Hydrocolloids as thickening and gelling agents in food: A critical review. J. Food Sci. Tech., 47: 587-597.

Sahasrabudhe, M.R. and W.J. Mullin, 1980. Dehydration of horseradish roots. J. Food Sci., 45: 1440-1443.

Scherz, H., 1996. Hydrocolloids, Stabilizers, Thickeners and Gelling Agents in Food, (German). Behr`s Ver-lag, Hamburg.

Vaisey, M., R. Brunon and J. Cooper, 1969. Some sensory effects of hydrocolloid sols on sweetness. J. Food Sci., 34: 397-400.