Changes in texture and organoleptic properties due to temperature and time during sous-vide Butternut squash preparation

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Abstract

Sous-vide (SV) is a technique where food is cooked under a vacuum at low temperatures for a long period of time. Usually, for meat, temperatures below 70 °C are used, while for vegetables temperatures are higher around 85 – 100 °C.

In this study the influence of various temperature and time combinations during sous-vide cooking on the textural and organoleptic attributes of Butternut squash was investigated for the first time. The raw control sample and 16 different combinations of vacuum cooking temperature/time were evaluated using texturometry and sensory analysis with 10 trained assessors. Based on the shear/toughness and firmness, optimal conditions were established as 70 °C/20 min and 70 °C/25 min. According to the sensory analysis these samples were different in parameters: orange colour, tenderness, fibrousness, and chewiness. The sous-vide sample cooked at 70 °C/25 min was evaluated as darker in orange colour, softer, more fibrous, and less chewable. Therefore, we suggest using this combination for sous-vide Butternut squash preparation.

Results

❑ From the average values measured by the texturometer (Table 1), it was found that for the work of the shear/toughness parameter and firmness, the highest values were recorded in the control raw sample.

❑ Among the SV samples, the highest values of the textural parameters were measured for the SV sample cooked at 85 °C/5 min and 75 °C/10 min.

❑ There were no statistically significant differences (α ≥0.05) detected for the firmness and work of the shear/toughness parameter for SV samples cooked at 70 °C and 80 °C at different time intervals.

❑ During the sensory evaluation of textural properties (hardness, fibrousness, and chewiness), the assessors identified as the hardest control sample (Figure 1). With increasing temperature and time, the point evaluation decreased, but not always statistically significantly.

❑ The raw pumpkin sample was considered the palest orange in comparison with all SV samples in orange colour intensity parameter.

❑ The best overall taste balance had the sample cooked at 75 °C/30 min. However, the difference in comparison with other samples was not significant (α ≥0.05).

❑ The effect of different vacuum cooking times and temperatures on textural and organoleptic parameters in pumpkin samples were not evaluated in the research studies.

Material and Methods

▪ Butternut squash (*Cucurbita moschata* Duch. Ex Poir.) was obtained from the Botanical Garden of SUA in Nitra.

▪ The 200 g/vacuum packaged samples were cooked at different temperatures (70, 75, 80, and 85 °C) and times (5 – 30 min) (sous-vide technique).

▪ The textural properties of samples were measured by a texturometer TA.XT plus with Warner Bratzler shear blade.

▪ Ten trained sensory assessors took part in the sensory analysis. A total of 8 sensory parameters were evaluated on a 9-point intensity scale (1-the lowest intensity, 9-the highest intensity).

▪ Results were statistically evaluated using the Shapiro-Wilk test, ANOVA, and Tukey's test at a significance level of α ≤0.05 (XLSTAT software, v.2023.1.6).
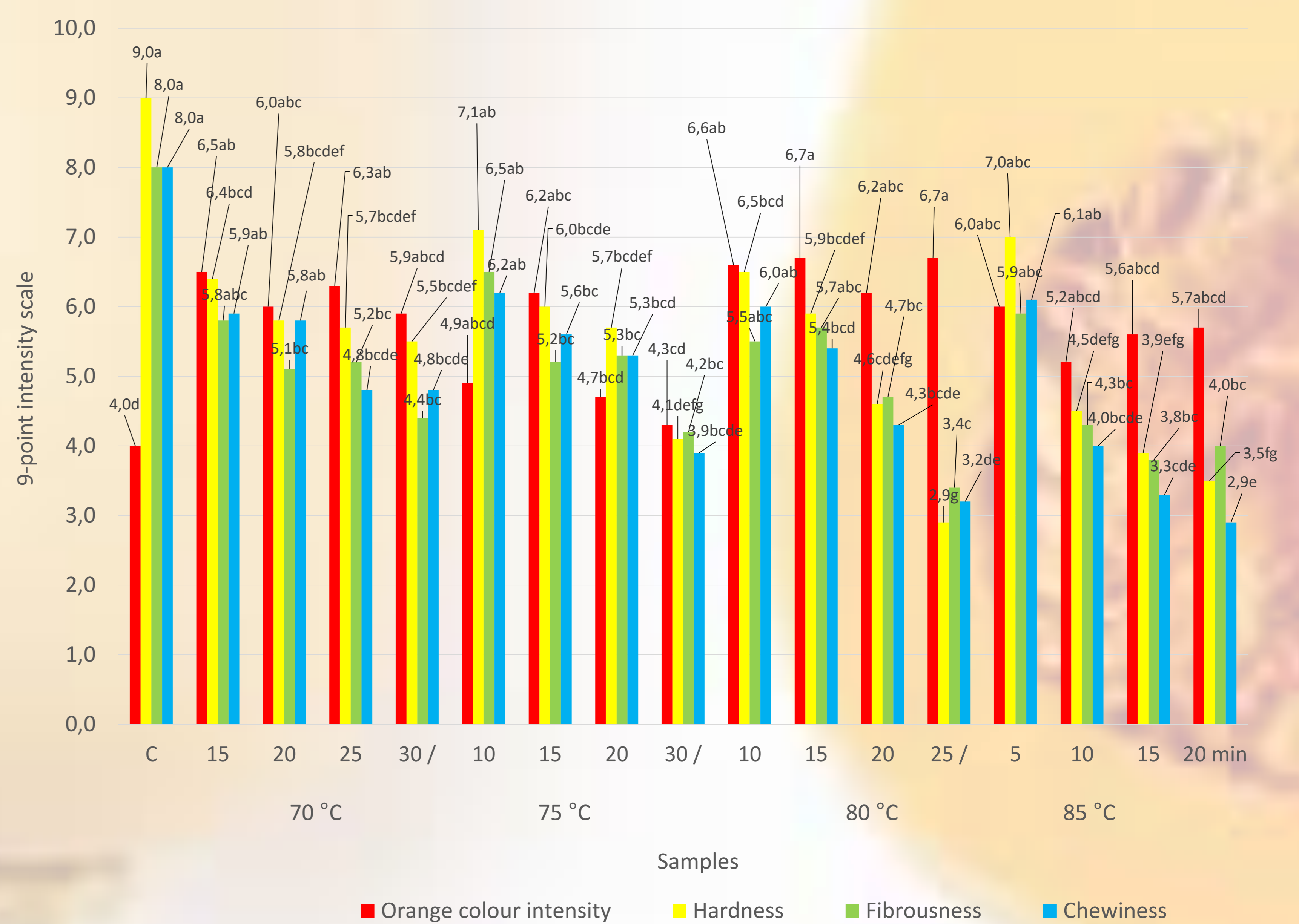
Figure 1: Effect of different combinations of temperature and time of vacuum cooking on organoleptic properties of SV Butternut squash. Values represent means of 10 sensory assessors. Different letters in superscript in the same parameter represent significant differences (α ≤0.05).

Table 1: Average measured values of work of shear/toughness and firmness

Temperature (°C)	Control	70				75				80				85			
Time (min)		15	20	25	30	10	15	20	30	10	15	20	25	5	10	15	20
Work of shear/toughness (N/mm.s)	36.01 ± 5.90ᵃ	5.79 ± 2.05ᶜᵈ	5.03 ± 1.99ᶜᵈ	4.70 ± 2.20ᶜᵈ	4.09 ± 1.41ᶜᵈ	13.47 ± 4.82ᵇ	7.82 ± 3.22ᶜ	7.29 ± 0.92ᶜ	5.15 ± 1.62ᶜᵈ	3.94 ± 1.28ᶜᵈ	3.33 ± 1.07ᶜᵈ	2.14 ± 0.89ᵈ	1.53 ± 0.69ᵈ	14.05 ± 3.47ᵇ	3.68 ± 0.49ᶜᵈ	3.61 ± 1.11ᶜᵈ	1.96 ± 0.42ᵈ
Firmness (N/mm)	3.44 ± 0.53ᵃ	0.63 ± 0.25ᶜᵈ	0.53 ± 0.17ᶜᵈ	0.49 ± 0.21ᶜᵈ	0.46 ± 0.16ᶜᵈ	1.47 ± 0.58ᵇ	0.87 ± 0.37ᶜ	0.79 ± 0.07ᶜ	0.55 ± 0.19ᶜᵈ	0.47 ± 0.17ᶜᵈ	0.38 ± 0.13ᶜᵈ	0.26 ± 0.11ᶜᵈ	0.18 ± 0.06ᵈ	1.43 ± 0.31ᵇ	0.42 ± 0.02ᶜᵈ	0.38 ± 0.08ᶜᵈ	0.19 ± 0.05ᶜᵈ

Note: Results are the mean ± standard deviation of measurements (n=6). Mean values in the same row with different letters are significantly different by Tukey's test (α ≤0.05).

Conclusions

✓ Based on the textural parameters, optimal combinations of temperature and time were 70 °C/20 min and 70 °C/25 min.

✓ The sample prepared for 25 min (70 °C) was evaluated as darker in orange colour, softer, more fibrous, and less chewable than 20 min (70 °C) even though there were no significant differences between these samples.

✓ According to our overall taste balance parameter results, 70 °C/25 min is the most suitable combination of vacuum cooking time and temperature for Butternut squash.

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