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Meat Technology — Special Issue 64/2

www.meatcon.rs ▪ www.journalmeattechnology.com

UDK: 637.521.4.057
641.526.3:637.521.4

ID: 126608649

https://doi.org/10.18485/meattech.2023.64.2.71

Original scientific paper

The effect of sample temperature on sensory quality of caseless sausages — cevap

Čaba Silađi[a], Vesna Đorđević[a], Volker Heinz[b], Nino Terjung[b], Franziska Witte[b] and Igor Tomašević[b]*

[a] *Institute of Meat Hygiene and Technology, Kaćanskog 13, 11000 Belgrade, Serbia*
[b] *DIL German Institute of Food Technologies, Prof.-v.-Klitzing-Str. 7, 49610 Quakenbrueck, Germany*

ARTICLE INFO

Keywords:
Sensory analysis
Pork meat
Beef meat
Algae

ABSTRACT

This study analyzes the impact of the addition of three different types of algae (White *Chlorella vulgaris*, *Himanthalia elongate* (sea spaghetti), and *Undaria pinnatifida* (wakame)) at two concentrations (1.5% and 3%) on the sensory characteristics of caseless sausages (cevap) served at two different temperatures. The aim of this study was to compare the color, smell, taste, texture, juiciness, and overall acceptability of the reheated samples with those served at room temperature. The results show that cevap with wakame had the lowest scores, while white *Chlorella* had no significant effect on the sensory parameters compared to the control sample. The overall acceptability of the three cevap types was significantly higher when they were served warm than when served cold, while the color, taste, texture, and juiciness parameters were different for one of the tested samples, proving that cevap needs to be served warm.

1. Introduction

The food industry and consumers are becoming more interested in food products supporting health and well-being. These foods are generally known as functional foods, as they provide health benefits above and beyond simple nutrition (*Sloan*, 1999). However, these types of healthy foods often have a negative impact on sensory attributes, so it is necessary to determine whether they are acceptable to potential consumers.

Over the past few decades, consumer evaluation has been widely used to assess the acceptability and quality of food products, including meat. One of the most established techniques in sensory characterization is asking consumers what they think of a product through liking or preference questions, using hedonic scales (*Torrico et al.,* 2018). The gold standard in sensory evaluation for liking is the *Peryam and Girardot* (1952) 9-point hedonic scale, although several modifications are used nowadays. This kind of estimation is common in the food and meat industries and offers accurate quantitative information on the acceptability of the product. Hedonic tests are used to determine how much a product is liked, using scales ranging from like extremely, through neither like nor dislike, to dislike extremely (*Torrico et al.,* 2018).

To avoid preparation effects, the samples for sensory comparison should all be prepared according to a uniform procedure. Before beginning sensory testing, preparation steps should be standardized throughout the preliminary testing and carefully recorded to ensure uniformity. Each sample should be offered at the same temperature as the usual serving temperature for the food type being evaluated. Some foods must be served warm or reheated to develop their particular flavor or aroma (*Watts et al.,* 1989).

***Corresponding author:** Čaba Silađi, *caba.siladji@inmes.rs*

Paper received Jun 23rd 2023. Paper accepted July 2nd 2023.
Published by Institute of Meat Hygiene and Technology — Belgrade, Serbia

The evolution of consumer perceptions, expectations, and needs created additional quality and sensory criteria that meat producers must satisfy (*Bredahl,* 2004). For this reason, meat products are increasingly often improved and reformulated with bioactive components, while removing some of the fat and salt (*de Medeiros et al.,* 2021). Algae can be used to develop functional foods, as they are a significant source of biologically active substances, and their inclusion increases food quality, reduces the need for chemical preservatives, and provides other health benefits (*Scieszka & Klewicka,* 2019). Systematic information on the amounts of seaweed used to reformulate meat products cannot be provided, as these amounts depend on the desired technological, nutritional, functional, or sensory effects, as well as on the type of algae (*Gullón et al.,* 2020).

In this study, three types of algae (white *Chlorella vulgaris*, *Himanthalia elongata* (sea spaghetti), and *Undaria pinnatifida* (wakame)) were added to cevap in two concentrations (1.5% and 3%) to investigate the effects of these ingredients on sensory characteristics while served reheated on the first day and at room temperature on the second day. Also, this article aimed to examine the influence of the sample temperature on the same parameters.

2. Materials and methods

2.0.1. Ingredients

Commercial fresh post-rigor pork shoulder with fat, and beef neck and shoulder clod with fat were obtained from Landschlachterei G.H. Diekmann (Essen Oldenburg, Germany). White *Chlorella vulgaris* powder was purchased from Aliga microalgae (Hjørring, Denmark), while sea spaghetti and wakame powder were purchased from Alganex (Berlin, Germany).

2.0.2. Meat preparation

Cevap was prepared at the German Institute of Food Technologies (DIL e.V., Quakenbrück, Germany) according to an industrial processing protocol. The entire study was performed on two consecutive days. On each day, seven different cevap formulations (Table 1) were prepared according to a standard industrial recipe as follows: 89% meat mixture with fat (49% beef, 40% pork) and 11.0% ice water, while 1.4% salt, 0.6% dextrose and algae (1.5% and 3%) were added "on top". Pork and beef meats were standardized to S III (with 12% fat) and R II (with 8% fat), according to the GEHA meat classification system (*Hack et al.,* 1976). The meat was ground through a 7.8mm sieve, salted with NaCl, covered with foil, and stored overnight at 4°C. Dextrose, salt, and algae were then added to all treatments (except the control, which contained no algae) and mixed in a bowl chopper (5000 Express, 30 l, KILIA GmbH, Birmingham, UK). The mixtures were formed into cylindrical shapes of approximately 2 cm in diameter and 8 cm in length using a vacuum filler (VF 608 plus, Albert Handtmann Maschinenfabrik, Biberach der Riss, Germany). After shaping, the cevap was baked on an electric grill (GGM Gastro International, Gronau, Germany) until an internal temperature of 75°C was reached and cooled at room temperature.

Table 1. Formulation of cevap with different algae per batch

Ingredients (g)	Groups						
	K	**C 1.5%**	**C 3.0%**	**S 1.5%**	**S 3.0%**	**W 1.5%**	**W 3.0%**
Beef meat (R II)	2450	2450	2450	2450	2450	2450	2450
Pork meat (S III)	2000	2000	2000	2000	2000	2000	2000
Ice	550	550	550	550	550	550	550
Salt	80	78.5	75	78.5	75	78.5	75
Dextrose	27.5	27.5	27.5	27.5	27.5	27.5	27.5
White *C. vulgaris*	/	75	150	/	/	/	/
Sea spaghetti	/	/	/	75	150	/	/
Wakame	/	/	/	/	/	75	150

K – Control cevap, C – Cevap with C. vulgaris, S – Cevap with sea spaghetti, W – Cevap with wakame

2.0.3. Sensory evaluation

The sensory evaluation of the cevap (color, smell, taste, texture, juiciness, and overall acceptability) was performed with a panel of 14 trained people with experience in sensory tests of meat products and of good general health condition with BMI between 18 and 25 kg/height in m^2, as recommended by *Forde et al.* (2013), on two consecutive days. A 7-point hedonic scale test was used with the following attributes: 1 — I absolutely dislike it, 4 – I moderately like it, 7 – I absolutely like it. During the test, panelists received a cevap of each sample labeled with a randomized three-digit number. On the first day, the samples were reheated in a microwave oven at 800W for 30 seconds before the evaluation, while on the second day, the cevap was served at room temperature. Still mineral water was used to clean the palate between samples.

2.0.4. Statistical analysis

Statistical analysis was performed using SPSS (SPSS 23.0, Chicago, IL, USA) software. The difference between mean values were tested using one-way ANOVA, Tukey's post hoc test, and t-test of paired samples ($p < 0.05$).

3. Results and discussion

The results of the sensory analysis with reheated cevap (Table 2) indicated that the use of different algae had a significant influence ($p < 0.05$) on 4 out of 7 parameters.

In terms of color, the results showed that the cevap with Wakame was the least likable compared to the rest of the cevap. W3 received lower scores (3.14), compared to the control (4.57) and samples with other algae, while W1.5 (4.07) was less desirable only compared to S1.5, which received the highest scores (5.50). Regarding smell, W3 received significantly lower marks (3.42) compared to the control sample (4.92). In respect of taste, the control samples were the best (5.14), while cevaps with *Chlorella* were insignificantly lower rated. Both samples with wakame were significantly less tasty (3.21 and 2.64, respectively) relative to control and cevap with *Chlorella*, S3 had also weaker scores (3.71) than the control, and S1.5 showed significantly higher scores (4.21) compared to W3. Similarly, the overall acceptability was the highest in control cevap (5.42), while cevap containing wakame was the least preferable (3.35 and 2.64, respectively), since they had significantly poorer results compared to C1.5, C3, and S1.5. S3 also had significantly lower scores (3.64), compared to the control. No significant difference was found between the batches in terms of texture and juiciness.

The sensory evaluation of the cevap served at room temperature showed similar results to reheated samples in terms of the best and worst ranked samples, but generally with lower mean values for every parameter. Statistically significant differences between batches ($p < 0.05$) were found in color, smell, taste, and overall acceptability (Table 3).

W3 had the lowest score (2.00) for color that was significantly lower compared to all other samples, the color scores of which varied from 3.28 to 4.35. In terms of smell, only between control (4.28) and W3 (2.71) was a meaningful difference found. Cevap without algae earned the highest score for taste (4.64) and the panelists favored them com-

Table 2. Sensory properties of the reheated cevap containing algae

Parameters	K (N=14)	C1.5 (N=14)	C3 (N=14)	S1.5 (N=14)	S3 (N=14)	W1.5 (N=14)	W3 (N=14)
	Mean values						
Color	4.57^{ab}	4.64^{ab}	5.00^{ab}	5.50^{a}	5.00^{ab}	4.07^{bc}	3.14^{c}
Smell	4.92^{a}	4.50^{ab}	4.07^{ab}	4.50^{ab}	4.42^{ab}	3.64^{ab}	3.42^{b}
Taste	5.14^{a}	4.78^{ab}	4.50^{ab}	4.21^{abc}	3.71^{bcd}	3.21^{d}	2.64^{d}
Texture	4.64	4.42	4.85	4.85	4.28	4.28	3.92
Juiciness	4.92	4.28	5.14	5.07	3.85	4.50	4.00
Overall acceptability	5.42^{a}	4.57^{abc}	4.71^{ab}	4.50^{abc}	3.64^{bcd}	3.35^{cd}	2.64^{d}

^{a,b,c,d} Different superscripts within a row indicate a significant difference ($P < 0.05$)

K – Control cevap, C – Cevap with *C. vulgaris*, S – Cevap with sea spaghetti, W – Cevap with wakame

Table 3. Sensory properties of the cevap containing algae served at room temperature

Parameters	K (N=14)	C1.5 (N=14)	C3 (N=14)	S1.5 (N=14)	S3 (N=14)	W1.5 (N=14)	W3 (N=14)
	Mean values						
Color	4.21^{a}	4.00^{a}	4.21^{a}	4.35^{a}	3.85^{a}	3.28^{ab}	2.00^{b}
Smell	4.28^{a}	3.71^{ab}	3.64^{ab}	4.07^{ab}	4.21^{ab}	3.42^{ab}	2.71^{b}
Taste	4.64^{a}	3.64^{abc}	3.50^{abc}	4.07^{ab}	3.00^{bc}	2.78^{bc}	2.35^{c}
Texture	4.35	3.78	4.28	3.64	3.71	3.71	3.42
Juiciness	4.42	4.21	4.14	4.71	3.92	4.42	4.21
Overall acceptability	4.50^{a}	3.57^{ab}	3.35^{abc}	4.07^{ab}	3.00^{bc}	2.92^{bc}	2.07^{c}

^{a,b,c,d} Different superscripts within a row indicate a significant difference ($P < 0.05$)

K – Control cevap, C – Cevap with *C. vulgaris*, S – Cevap with sea spaghetti, W – Cevap with wakame

Table 4. Differences in cevap sensory properties according to serving temperature of the same cevap

Parameters	K (N=14)	C1.5 (N=14)	C3 (N=14)	S1.5 (N=14)	S3 (N=14)	W1.5 (N=14)	W3 (N=14)
	Mean values						
	Color						
Reheated cevap	4.57	4.64	5	5.50^{a}	5	4.07	3.14
Cevap at room temp.	4.21	4	4.21	4.35^{b}	3.85	3.28	2
p	0.336	0.145	0.102	0.017	0.052	0.222	0.063
	Smell						
Reheated cevap	4.92	4.5	4.07	4.5	4.42	3.64	3.42
Cevap at room temp.	4.28	3.71	3.64	4.07	4.21	3.42	2.71
p	0.189	0.085	0.407	0.234	0.568	0.678	0.224
	Taste						
Reheated cevap	5.14	4.78^{a}	4.5	4.21	3.71	3.21	2.64
Cevap at room temp.	4.64	3.64^{b}	3.5	4.07	3	2.78	2.35
p	0.336	0.026	0.058	0.671	0.065	0.407	0.336
	Texture						
Reheated cevap	4.64	4.42	4.85	4.85^{a}	4.28	4.28	3.92
Cevap at room temp.	4.35	3.78	4.28	3.64^{b}	3.71	3.71	3.42
p	0.591	0.108	0.263	0.029	0.135	0.283	0.278
	Juiciness						
Reheated cevap	4.92	4.28	5.14^{a}	5.07	3.85	4.5	4
Cevap at room temp.	4.42	4.21	4.14^{b}	4.71	3.92	4.42	4.21
p	0.439	0.890	0.024	0.336	0.893	0.888	0.620
	Overall acceptability						
Reheated cevap	5.42	4.57^{a}	4.71^{a}	4.50	3.64	3.35	2.64^{a}
Cevap at room temp.	4.50	3.57^{b}	3.35^{b}	4.07	3.00	2.92	2.07^{b}
p	0.097	0.005	0.038	0.336	0.108	0.451	0.026

^{a,b} Different superscripts within a column and within each sensory parameter indicate a significant difference ($P < 0.05$)

K – Control cevap, C – Cevap with *C. vulgaris*, S – Cevap with sea spaghetti, W – Cevap with wakame

pared to S3, W1.5, and W3. The only other cevap with a score above 4 was S1.5, which received also significantly higher grades compared to the least likable W3 (2.35). Similarly, in overall acceptability, the best cevap was the control (4.50), while only S1.5 received a similar score above 4.00. These two batches, followed by C1.5 (3.57) had a significantly higher grade compared to W3 (2.07). The control cevap was also considerably more acceptable than S3 (3.00) and W1.5 (2.92).

Within this research, the t-test of paired samples was used to examine whether there were statistically significant differences ($p < 0.05$) for the above-mentioned six parameters in respect of the serving temperature of the same cevap.

Based on the results shown in Table 4, it can be concluded that there was a statistically significant difference in the color of S1.5, the taste of C1.5, the texture of S1.5, the juiciness of C3, and the overall acceptability of C1.5, C3, and W3, where reheated cevap had a significantly higher degree of liking in all cases.

4. Conclusion

The addition of Wakame and Sea spaghetti had a significant impact on the sensory characteristics of cevap. Color, smell, taste, and overall acceptability scores were the most reduced with the addition of wakame, regardless of the cevap serving temperature. The incorporation of sea spaghetti at a higher concentration (3%) also decreased the results for taste and overall acceptability at both serving temperatures, while *Chlorella vulgaris* had no significant effect on the sensory properties of the cevap. On the other hand, the temperature of the cevap used for this study had a significant effect on the level of the reported sensory properties. The overall acceptability of the three cevap types was noticeably higher when they were served warm compared to colder ones, while the color, taste, texture, and juiciness parameters were different for one of the tested cevap. These results support the fact that cevap needs to be served fresh from the grill or reheated during sensory analysis to reach their full sensory potential.

Disclosure statement: No potential conflict of interest was reported by the authors.

Funding: This study was supported by the Ministry of Science, Technological Development and Innovation, Republic of Serbia, Grant No. 451-03-47/2023-01/200050 from 03.02.2023 and the German Federal Ministry of Education and Research (BMBF) (Bridge2ERA2021: 100579052).

Acknowledgements: The authors would like to thank the German Institute of Food Technologies (DIL e.V., Quakenbrück, Germany) for the excellent working conditions and the survey respondents for generously giving their time and sharing their experiences on meat consumption.

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