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Impact of Temperature on the Salty Taste Perception of Reduced Salt Ayran

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Abstract

In recent years many efforts have been made to limit the use of salt in processed foods. Ayran is among the dairy foods that contain salt and is a type of fermented milk drink widely consumed in Turkey. Temperature of the food at consumption can influence many of its sensorial properties as well as the salt perception. In this study we investigated the impact of serving temperature of ayran on the saltiness scores at sensory panel. Ayran samples were produced at three salt levels; 0.2, 0.5 and 0.8%; and they were served at 3 different temperatures (4, 15 and 24˚C) for the sensory evaluation. Chemical composition, pH, viscosity, whey separation and sensory properties were determined. Temperature influenced the sensory saltiness scores significantly ($p<0.05$). Saltiness scores were higher at low temperatures.

Keywords: Saltiness perception, Temperature, Ayran, Salt reduction, Sensory

Research article
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INTRODUCTION

Ayran or so-called yogurt drink is a popular fermented milk drink in Turkey. It is principally produced by diluting the yogurt with water and adding salt. According to fermented dairy products bulletin (TGK, 2009), salt concentration should not exceed 1% in Ayran. High salt intake is associated with several health problems such as cardiovascular diseases and hypertension. According to World Health Organization, daily salt intake should be less than 5 g, and for children under 15 years old much lower levels (less than 2 g/day) are recommended (Anonymous, 2012). Many studies have been done in order to reduce the salt content of foods. However, it has always been a challenge for the food industry to reduce the salt. Enhancing the saltiness perception of the food is another approach that can help reducing the salt content without sacrificing the consumer acceptance. Saltiness of the food is detected in the mouth when Na^+ ions react with taste receptor cells located on taste bud cells. An epithelial sodium channel (ENaC) in the taste cell wall allows sodium cations to enter the cell. Previous studies have shown the thermal sensitivity of taste nerves. Some taste fibers respond to thermal stimuli, and temperature dependency of salt responses was explained by the cold activation of ENaC and heat activation of the vanilloid receptor (TRPV1t). Cooling can enhance the detection of saltiness and/or sourness in the anterior part of the tongue (Talavera et al., 2007; Cruz and Green, 2000).

There are several studies showing the influence of temperature on saltiness perception, however most of these studies are employed using salt solutions solely. Few studies involved interactions between salt, acid and bitter compounds.

No previous study has been done before, examining the temperature dependency of saltiness perception of ayran to the author's knowledge. Objectives of this study include determining the impact of serving temperature on sensory scores and particularly saltiness perception, and to reduce the salt concentration of ayran to an acceptable level.

MATERIAL and METHOD

Preparation of Ayran Samples

Ayran samples were made at Harran University Department of Food Engineering laboratory by diluting the yogurt (Pınar A.Ş.) obtained from the market at 1:0.9 ratio. Ayran samples were made uniform by a hand blender after the water addition. Salt was added after dividing each batch into 3 parts at the concentrations of: 0.2%, 0.5% and 0.8%. Trial was replicated twice.

Composition and pH

Total solids determined by gravimetric method according to IDF (1982). % Fat was analyzed by Gerber method (IDF, 1991). pH was measured directly by inserting the probe of the pH meter (Thermo Scientific, USA) into samples. Acidity was measured according to Bradley et al. (1992).

Viscosity

Viscosity was measured using Brookfield Viscometer (Brookfield Model RVDV-II+, Brookfield engineering Laboratories. Inc. Middlesbrough UK.) with spindle no 3 at 100 rpm and 15s (Ozer et al., 1997). Sample temperature was 4˚C during measurement.

Whey Separation

100 ml sample was placed in graduated cylinder and kept at 4˚C until measurement. Once placing the samples, measurements were taken after 1 day, 2, 6, 15, 20 and 33 days from the same cylinders. Volume of the separated whey on top was measured (Ozunlu, 2005).

Sensory Evaluation

Sensory evaluation was done by a group of 10 experienced sensory panelists. Sensory panelists were elected after a screening test for determining their detection limits of basic tastes (salty, sour and sweet) (Meilgarrd et al., 2007). At first step, each panelist candidate was presented with salt (0,2 %), citric acid (0.07) and sugar (1.2%) solutions and they were expected to recognize and name salty, sour and sweet tastes correctly. At the second step, panelist candidates were presented with a set of salty (0,1, 0,2 and 0,4 NaCl), sour (0,035, 0,07 and 0,14% citric acid) and sweet (1, 2 and 4 % sugar) solutions and asked for ranking them according to their intensity. 10 panelists who passed the screening tests were participated in sensory analysis of ayran samples.

Each sensory panel was done with one set of 3 ayran samples at 4, 15 and 24 ˚C at one salt concentration level. Sensory panel was completed after all panelists evaluated all concentration levels (3 sets: 0,2%, 0,5% and 0,8% salt). Ayran samples were evaluated for saltiness, sourness, flavour and consistency using a just-about-right (JAR) 5-point intensity scale with 3 being just about right, < 3 not enough salt and >3 too much salt. Samples were evaluated using ranking test model according to Drake (2008).

Statistical Analysis

Statistical analysis was performed by SPSS version 16 (SPSS Inc., Chicago, IL). Analysis of variance (ANOVA) was done to establish statistical differences between the chemical, physical and sensory properties of the samples depending on ayran temperature, salt concentration and interaction between those two factors.

RESULTS and DISCUSSION

Chemical and Physical Properties

Chemical analysis results and viscosity of ayran samples are given in Table 1. No significant difference was observed between the pH, acidity, total solids and fat contents of ayran samples at different salt levels (P>0,05). Increasing the salt content to 0.5% resulted in higher viscosity. Köksoy and Kılıç (2003), observed a decrease in viscosity of the Ayran when salt content was increased from 0.5 to 1.0%. The decrease in viscosity was attributed to the increase in the repulsive forces created by salt ions on the surface of the micelles reducing the tendency of aggregation. In our study increasing the salt content from 0.5 to 0.8% lowered the viscosity a little but it was not significant (P>0.05). On the other hand, our results showed that at very low salt levels (0.2%) viscosity was significantly reduced possibly as a result of reduced protein-protein interactions due to low ionic strength.

Table 1. Chemical analysis results and viscosity of ayran samples having 0.2%, 0.5 and 0.8% salt

	Salt level (%)		
	0,2	0,5	0,8
pH	4,45 [a]	4,47 [a]	4,41 [a]
Acidity (lactic acid %)	0,57 [a]	0,57 [a]	0,53 [a]
Total solids (%)	8,2 [a]	8,3 [a]	8,3 [a]
Fat (%)	1,4 [a]	1,4 [a]	1,5 [a]
Viscosity (cP)	109,5[a]	130[b]	125,5[b]

[a,b,c] Means in the same row with different superscript letters are statistically different (P< 0,05).

Whey separation results of the ayran samples for 33 days are given in Fig. 1. Whey separation occurs in ayran due to the sedimentation of destabilized proteins by time. Whey separation is an inevitable phenomenon for ayran, however the time it takes for phase separation to occur is a quality parameter for ayran and should not be too fast.

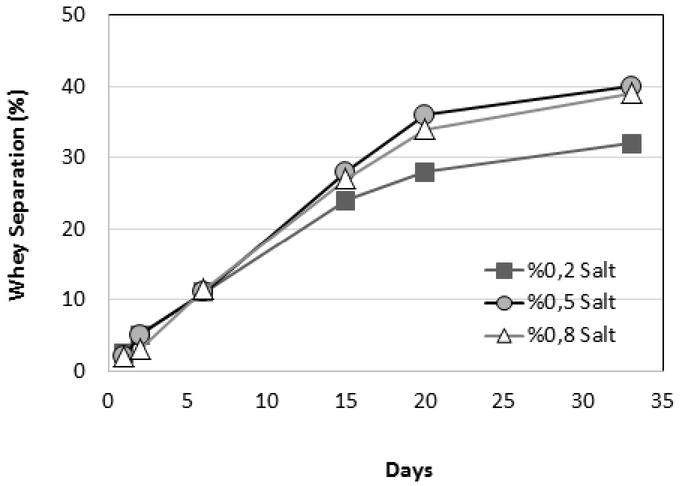

Figure 1. Whey separation results of ayran samples having 0.2% , 0.5 and 0.8% salt

Statistically significant increase was observed in whey separation during 33 days of storage. Whey separation levels didn't differ during the first week between samples having different levels of salt. However higher separation was observed at higher salt levels after day 15. Köksoy and Kılıç (2003), had also observed higher whey separation at high salt levels, where they only measured the whey separation on day 15. They attributed the higher whey separation at high salt levels to the rearrangement of the casein micelles involving increased protein–protein interactions.

Sensory Properties

Both salt level and temperature had significant influence on saltiness scores. According to fermented dairy products bulletin (TGK, 2009), salt concentration should not exceed 1% in ayran. In this study we found that, samples with 0,5% salt were scored (3) ideal, above 0,5% were found to be too much salty and samples with 0,2% salt were scored less than 3, meaning not enough salt (Table 2). Serving temperature influenced the saltiness scores significantly ($P<0.05$).

Saltiness perception of samples at low temperatures was higher. 70% of the panelists scored the 0.2% salty samples as JAR at 4˚C, while the same samples were found to be JAR by only 20% of panelists at 24˚C, and rest of the panelists scored them <3 (Fig. 2). At 0.5% salt level most of the panelists scored the samples 3 and >3. While no panelist found the samples having "not enough salt" at 4 and 15˚C, same samples were scored <3 by 36% of the panelists at 24˚C. Samples having 0.8% salt were found to be too salty by 60% of the panelists at 4 and 15˚C, while at 24˚C same samples were scored >3 by 40% of the panelists and some (10%) found them having not enough salt.

Ayran samples did not show any significant differences in terms of sourness and consistency as seen in Table 2. Different salt levels didn't influence the flavor except for 24°C samples, where samples with 0.2 % salt received low scores. Flavor scores tended to be close to ideal at low temperatures and as the temperature increase, 0.2 % samples were found to be below the ideal; and at 0.8 % salt level, samples had scores >3. No significant flavor difference was observed between different temperatures at 0.5% salt level.

Table 2. Sensory analysis results of ayran samples having 0.2% , 0.5 and 0.8% salt

Parameter	Salt level (%)	4 °C Mean		SD	15 °C Mean		SD	24 °C Mean		SD
Saltiness	0,2	2,60 [aA]	±	0,30	2,50 [abA]	±	0,30	1,90 [bA]	±	0,24
	0,5	3,18 [aB]	±	0,40	3,09 [abB]	±	0,30	2,81 [bB]	±	0,15
	0,8	3,80 [aC]	±	0,19	3,70 [abC]	±	0,17	3,30 [bC]	±	0,27
Sourness	0,2	3,00 [aA]	±	0,89	2,82 [aA]	±	0,60	2,91 [aA]	±	0,94
	0,5	3,00 [aA]	±	0,47	2,91 [aA]	±	0,54	3,27 [aA]	±	1,10
	0,8	3,27 [aA]	±	0,65	3,18 [aA]	±	0,40	3,36 [aA]	±	1,03
Flavor	0,2	3,18 [aA]	±	0,40	3,00 [aAB]	±	0,77	2,27 [bA]	±	0,90
	0,5	3,00 [aA]	±	0,00	2,73 [aA]	±	0,47	2,64 [abA]	±	0,92
	0,8	3,09 [aA]	±	0,70	3,27 [aB]	±	0,65	3,36 [aB]	±	1,12
Consistency	0,2	3,09 [aA]	±	0,30	3,00 [aA]	±	0,45	2,91 [aA]	±	0,70
	0,5	3,00 [aA]	±	0,00	3,09 [aA]	±	0,70	2,91 [aA]	±	0,70
	0,8	3,18 [aA]	±	0,60	3,09 [aA]	±	0,30	2,91 [aA]	±	0,30

[a,b,c]Shows differences between ayran samples at different temperatures. Means with different superscript letter in the same row are significantly different ($p<0.05$).
[A,B,C]Shows differences between ayran samples at different salt levels. Means with different superscript letter in the same column are significantly different ($p<0.05$).
SS: Standard deviation

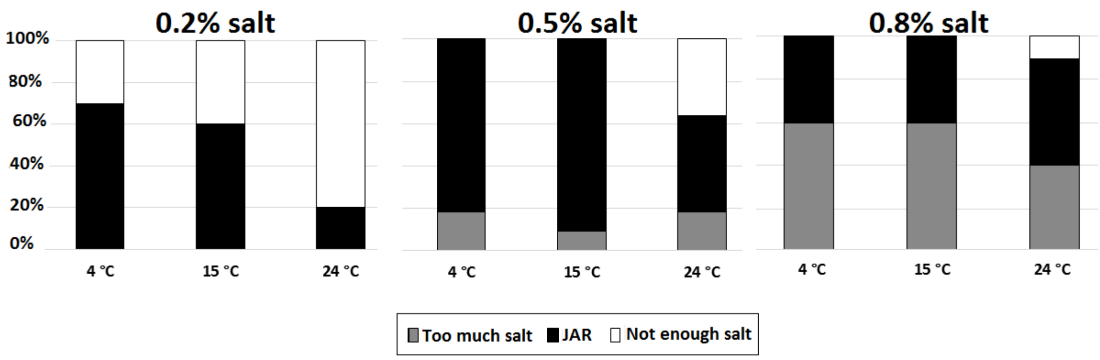

Figure 2. Saltiness intensity responses of ayran samples at 0.2, 0.5 and 0.8% salt levels

Several studies have shown that temperature influences the taste sensation, and many neurons in mammalian taste pathways respond to temperature. Kanno et al. (2016), studied the perception and thresholds of basic tastes under thermal stimulation of the tongue and they found that salty taste threshold increased for both the cool (10-13˚C) and hot (37-39˚C) stimulus. Lipscomb et al. (2016) did not find any influence of temperature on salty taste intensity when salt solutions were consumed alone. However, they have seen a significant effect of the temperature on the salty taste intensity when salt combined with acid. McBurney et al. (1973) reported that perceived salt intensity was higher at 17, 37 and 42°C as compared to intermediate serving temperatures of 22, 27 and 32°C, respectively.

They also showed that the detection threshold for salt was higher at temperatures 4 and 42°C and lower at temperatures 22 to 32°C. Paulus and Reisch (1980) suggested that perception of saltiness decreases as the temperature is increased. Cruz and Green (2000) reported that cooling the anterior edge of the tongue (chorda tympani nerve) can arouse sourness and/or saltiness. Our findings were also in accordance with most of the previous studies suggesting that cooling increase the salty taste intensity and perception of higher saltiness levels.

CONCLUSION

In this study our results showed that, serving temperature has a significant role on saltiness perception of ayran. Saltiness scores were higher at low temperatures. More than half of the panelists found the samples having “just about right” level of salt even at only 0.2% salt. This study demonstrated that reducing the salt content of the ayran to a certain extent could be unnoticeable at low temperatures.

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