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## **ARTICLE TITLE**

The Effect of Freshness in Foodservice Context

## **ABSTRACT**

The purpose of this research was to study how consumers respond to differences in the freshness of lettuce based only on sensory properties in the foodservice context. Another objective was to measure consumer response to the modification of the consumption context. Data was collected from consumer studies in two separate restaurants with three different products (n=238). The reference sample was a packaged ready-to-eat lettuce, which was compared using two freshly prepared samples. The results indicated that consumers did recognize differences between product properties that depend on the level of freshness when served in a foodservice environment. By serving fresh products, the perceived level of sensory quality showed a significant increase.

**Keywords:** Foodservice, Freshness, Vegetables, Fresh-cut, Sensory evaluation, Consumer perception, Lettuce, Context

### **1. Introduction**

The World Health Organization recommends consuming at least 400 g vegetables a day in addition to potatoes or starchy tubers (WHO/FAO Expert Consultation, 2003). National recommendations vary between different countries, but in general they are difficult to meet. In the year 2008 only four EU Member States reached the recommended levels (European Food Safety Authority, 2008). In many consumer studies, taste is usually mentioned as one of the main reasons for selecting food (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Lennernäs et al., 1997; Dalton, Linke, & Simko, 1986). One possible solution to reaching these recommended targets and promoting vegetable consumption could be by providing fresher and more agreeable vegetables in foodservices.

In Europe eating outside the home is responsible for a very significant part of the daily energy intake (Orfanos et al., 2009). This makes foodservices an important stakeholder in promoting healthy eating and vegetable consumption with a real possibility to have an impact on public health (Lachat et al., 2011)(Ko,

2009). Peoples' understanding of healthy eating still seems to be rather unclear (Ronteltap, Sijtsema, Dagevos, & de Winter, 2012). The intention to eat healthily is not always easily achieved in practice (Bublitz, Peracchio, & Block, 2010). People think that they should eat healthily, but they still place more emphasis on the aesthetic qualities of food (Spiteri-Cornish, 2012). Adding fresh and tastier vegetables to foodservices might have an influence on healthy eating. An earlier study suggested that to increase the consumption of healthy foods, they should be made to look and taste better (Neumark-Sztainer, Story, Perry, & Casey, 1999). Studies show that customer satisfaction is positively connected to loyalty (Jung & Yoon, 2012) and that satisfaction induces repeated visits (Valle, Silva, Mendes, & Guerreiro, 2006). If consumers recognize an increased level of freshness and improved taste, the proportion of healthy components could be increased. For foodservices this could be realized as increased customer flow.

Freshness is a product property which is usually associated with such synonyms as newly made, recently prepared or harvested. Freshness can represent itself to consumer depending on individual preferences through at least three separate means: sensory quality in its many forms, personal values, and product information. The multidimensionality of freshness is highlighted by the fact that it is dependent on color and appearance, flavor, texture and nutritional properties (Péneau, Hoehn, Roth, Escher, & Nuessli, 2006). Personal values and attitudes are more closely related to those product properties which are valued by individual consumer (Dinnella, Torri, Caporale, & Monteleone, 2014). Information based freshness is attached to the information given, for example, the expiry date (Ragaert, Verbeke, Devlieghere, & Debevere, 2004). In addition other sorts of information such as the origin of the food may create hedonic expectations (Caporale, Policastro, Carlucci, & Monteleone, 2006). Without any information, the consumer can only rely on his/her senses to decide on the product's freshness. Thus, freshness is a rather elusive term having a wide variety of meanings depending on the context and products. Freshness can be measured, but single measurements usually indicate only one aspect of the complexity. For this reason, sensory perception is usually more reliable method to predict consumer liking.

Due to changes in consumption patterns and increased competition in the foodservice industry, there is a growing demand for minimally processed ready-to-use products (Rodgers, 2008). Even though such products as ready-to-eat vegetables have become more popular at home, they can cause suspicion among some

consumers (Behrens et al., 2010). To streamline the commercial processes, there is an increased interest in the use of technological aids to prepare the ingredients of a salad buffet. With technological assistance, it would be possible to increase the amount of fresh-cut vegetables in the high volume foodservice restaurants. According to Rozin & Tuorila (1993) many non-food contexts can have an influence on food acceptance. Kotler (1973) described atmosphere as being something that can be described in sensory terms. According to him, atmosphere has the ability to effect the customers' information and affective state. Consumers also tend to be suspicious towards prepared meals and different methods of food processing (Creed, 2001). It is yet unclear whether technology-aids inside the restaurant can have an effect on context or atmosphere. In commercial restaurants, it poses a high risk to change familiar concepts with factors that have the possibility to be experienced negatively. On the other hand, seeing lettuce prepared may have a positive effect on atmosphere. The consumer could gain information about the product, which is possible only when seeing the lettuce prepared. Because of this, the possible consequences of new practices need to be tested.

The objective of this research was to study how consumers respond to differences in the freshness of lettuce as a part of a lunch buffet. The area of special interest was whether consumers could identify differences in the quality of the lettuce served based only on sensory properties. Another objective was to measure consumer response to the modification of consumption context. In normal conditions, customers do not have visual contact with the preparation phase of the lettuce. In this study, the modification of the consumption context was the preparation of the lettuce in the restaurant.

## **2 Materials and methods**

### *2.1 Description of sample material*

Altogether three test samples were used constituting of two different products. All the samples and details concerning packaging are described in Table 1. Lettuces were supplied by a contract manufacturer and packaged material had a seven day shelf-life after packaging. The packaged lettuce was stored in the restaurants' cold rooms (+6°C) and served to the customers five days after packaging and fifteen days after

picking. A ready-to-eat minimally processed lettuce was used as a reference sample representing the level of freshness of lettuces typically served in each particular restaurant.

Two different fresh-cut samples were used in this study. Both the samples were freshly cut from iceberg lettuce heads by professionally trained kitchen staff immediately before serving. Just before cutting and serving the unprocessed lettuce all discolored and wilted parts were removed and the lettuces kept in ice water to maximize crispness. The difference between these two samples was the modification of the consumption context. The first fresh-cut sample was cut in the restaurant kitchen with the customers having no visual contact to the preparation. In this case, consumer responses to product quality were based only on lettuce's sensory properties. The lettuce head was cut and delivered to the serving point as the level in the serving trays reached the point to be re-filled.

The other unprocessed sample was also freshly cut in the same manner, but this time the preparation took place in the restaurant. In this case, customers had a view to the lettuce preparation and cutting. The modification of the consumption context was provided by letting the customers visually see the actual cutting operation. The preparation area was located to the rear end of the restaurant behind a counter, which divided the space between personnel and customer areas. Customers did go by the preparation area as they proceeded along the buffet line. The person doing the cutting re-filled the service trays as during the cutting.

Lettuce was served as a part of buffet table, where customer could choose from a wide variety of salads, vegetables, and hot dishes. Only one of the above described samples was served at a time. Lettuce heads were supplied and used for processing according to Finnish commercial practices.

## *2.2 Instrumental methods analyzing for sample quality*

The quality of test samples was evaluated with two different instrumental methods to document the state of freshness. Analyzed samples were randomly collected from the same batch as used in the consumer study.

### *2.2.1 Color measurement*

The equipment used in color measurement consisted of a digital camera (Go – 5, QimagingLtd) with a zoom lens (Computar M6Z 1212-3S), adjustable stand (Kaiser RSX, *Kaiser Fototechnik GmbH*), and image

analysis software (Image Pro Plus 7.0, Media Cybernetics) with plugin programs (“Color Lab” and calibration macros by Cheos Co.). Sample material was collected from the same lunch serving as the consumer study, transported to a laboratory nearby in an insulated package and measured immediately.  $L^*$  (lightness),  $a^*$  (redness) and  $b^*$  (yellowness) were measured. The CIE  $L^*a^*b^*$  parameters were converted to chroma  $(a^2 + b^2)^{1/2}$ .

### 2.2.2 Texture analysis

Texture properties of the iceberg lettuce were analyzed with a TA-XT2 texture analyzer (Stable Micro Systems Ltd., Godalming, UK) with a 5 kg load cell. The measurement was replicated 20 times with randomly selected samples. Sample material was collected from the same lunch serving as the consumer study, transported to a laboratory nearby in an insulated package and measured immediately. The tests were done as puncture tests with a 2mm probe (P/2) and the speed setting for the experiment was 1 mm/s. The lettuce texture was assessed by maximum load (N) and break energy (mJ).

### 2.3 Consumer study

The consumer study took place in two separate restaurants in two different towns. The larger town has ca. 60 000 inhabitants and is the regional capital. The smaller town has approximately 14 000 inhabitants and is located in a rural area. If information about the product origin, manufacturing process or expiry date was made available, it was thought it may have an effect on consumer expectations. The restaurant in the larger town typically had 300 customers per day and the smaller one about 100 customers. Both restaurants are part of international restaurant chain focusing on foodservice, catering and cafeterias. Both restaurants served only buffet lunch. Lunch was served from 10.30 a.m. to 2 p.m. while the peak hour was typically during the first two hours. Data was gathered during this time period as a part of the normal lunch serving.

The consumers were recruited as part of the study by contacting them at the entrance to the restaurants and asking them to complete a questionnaire. At no time was the actual purpose of the study introduced. If the customers did ask, they were informed that the purpose of the study was to collect user experiences of

iceberg lettuce. The instructions were to complete a questionnaire after eating. Each participant was rewarded with a free dessert. The data was gathered during four test days. Iceberg lettuce was part of the normal lunch buffet serving, among a selection of warm dishes and vegetable components. Only one of the three possible samples was available at once.

The questionnaire included background questions and evaluation of different quality factors of iceberg lettuce. The background questions included year of birth, gender, special diets, the usage of vegetables and the most important attribute of salad (color, crispiness, taste, freshness or other). For the particular sample the customers had, they were also asked to evaluate the pleasantness of appearance, color, taste and texture (5-point structured scale: 1 = very unpleasant- 5 = very pleasant). Customers returned the questionnaires, after finishing their meal to a separate collection point and received a free dessert for the completed form. Last section of the questionnaire was a possibility to freely comment on the quality of the lettuce.

#### *2.4 Data analysis*

The differences between pleasantness ratings for lettuces were tested with Kruskal-Wallis one-way analysis of variance. The differences were tested for each property separately. The Kruskal-Wallis test was chosen as it is a non-parametric method, which does not assume normal distribution. The difference between each sample was tested pair wise with the Mann-Whitney U test. For the color analysis of lettuce samples, the Mann-Whitney U test was used because of the small sample size. The Mann-Whitney U test is a non-parametric equivalent for t-test for non-normal distributions. All the tests are considered as significant for  $p \leq 0.05$ . To control the multiplicity effect, False Discovery Rate (Benjamini & Hochberg, 1995) was used.

Statistical analysis was also done to test differences between genders and age groups with the Mann-Whitney U test.

All statistical analyses were performed with IBM SPSS Statistics, version 22.

### **3 Results and Discussion**

Each individual consumer evaluated only one of the three samples. Altogether 238 questionnaires were collected each representing one evaluated sample. Some participants did not answer all the questions which

can be seen from the sample sizes. The results from the product pleasantness evaluations for the different qualities of the lettuce are presented as mean values with standard deviations (Table 2). The scores have been calculated from hedonic data where very unpleasant equals one (lowest score) on a discrete scale and very pleasant equals five (highest score). Each sample is tested pair wise against the other samples within every attribute for statistically significant differences. Results show distinct differences between the evaluation of fresh-cut and packaged lettuces. Results from consumer studies based on gender are presented in Table 3.

The combined results from instrumental measurements and consumer studies are presented in Figure 1. The scales for different variables differ from each other significantly. To enable direct comparison between the different variables, the values have been normalized. In this context, normalization means that the sample with a larger absolute value equals 1.0. When only comparing two different samples, the smaller value is divided with by larger number. The presented values describe the proportion between the two values. The original measurement data is not shown.

For the sensory results the difference was statistically significant between color and texture. For the color parameters, the  $a^*$ - and chroma-values, the difference was statistically significant. Results indicate that the greater  $a^*$ - and chroma-values correlate with better sensory quality (Figure 1). It has been shown that in the case of foods, greater chroma values are typically preferred (Lee, Lee, Lee, & Song, 2013). The luminosity for packaged lettuce is at a slightly higher level than for fresh-cut lettuce. Usually, lettuce luminosity tends to decrease during storage due to browning (Martin-Diana et al., 2006). The perceived quality of texture seems to correlate with the lower break energy and maximum load. Previous studies have shown that the maximum load increases significantly during storage (Martin-Diana et al., 2005; Martin-Diana et al., 2006). This is generally considered to be due to the increasing tissue elasticity which is caused by tissue dehydration. Instrumental measurements executed in this study gave similar results. Because only two samples were compared, this will require further studies.

Gender had a certain effect on the evaluations in the consumer study (Table 3). Female participants gave slightly higher scores to all the samples and product properties; difference between genders was on average 5.5 %. This may infer that women have generally higher interest toward fresh fruits and vegetables, which



also manifests itself as higher scores in consumer studies also. A previous study showed similar tendency with apples (Péneau et al., 2006). The fresh-cut samples, which were prepared in the restaurant kitchens, had statistically significant differences concerning all the other product properties except appearance. In addition, for the packaged lettuce samples there were statistically significant differences concerning color and texture. No statistically significant differences were found in the restaurant prepared samples. Men tended to give the restaurant prepared samples slightly higher evaluations compared to kitchen prepared samples, whereas female participants showed an opposite tendency. However, the difference was not statistically significant, this may infer that male respondents may value restaurant prepared produce more than the female participants. To verify this effect would require further studies. In general, women tend to value freshness and health aspects more than men (Lennernäs et al., 1997; Fernqvist & Ekelund, 2014). Lettuce is generally considered to be a healthy product. This is the probable cause that product pleasantness for female participants was higher in every category. The number of respondents was considerably higher for women, which may have effect on the results.

Data was also tested by dividing it into approximately equally-sized groups based on their age (<45, 45-54, 55+ years old). Statistically significant differences were only found in the age group 45-54 years, when appearance and color had a p-value below 0.05 (data not shown). In both these cases, the difference between fresh and packaged lettuce was greater than in other age groups.

Consumers could identify the difference in freshness between packaged and fresh-cut lettuces. Packaged lettuce received the lowest evaluations in every category. Based on the results of the pair wise comparisons, statistically significant differences occur for color and texture (Table 2). In addition, the p-value for the difference of appearance between packaged and kitchen cut was below significance level (0.019). In this case, it cannot be considered to be significant after applying a False Discovery Rate (Benjamini & Hochberg, 1995). The results also indicate that consumers recognize the product freshness and taste, when the product is not freshly prepared. They also experience the lowered sensory properties, which has a distinct effect on the overall quality. A study concentrating on minimally processed vegetables found that freshness is the most important attribute both at the purchasing and consumption stages (Ragaert et al., 2004). The same study showed that in addition to convenience, the main reasons for repeated purchase were delicious taste, and

freshness. This might infer that in a foodservice context serving fresh, high quality vegetables instead of currently used ready-to-eat products could also encourage customers to return to the same restaurant.

No significant differences were found between the fresh-cut samples. It is known that the context in which food is consumed can have a significant effect on food acceptance (Rozin & Tuorila, 1993; Ko, 2010). Recent study (Piqueras-Fiszman & Jaeger, 2014) showed that the food consumption contexts may also have a significant effect on product related emotion profiles. Moreover, if the context is inappropriate in relation to the product, it may evoke negative associations towards the product. People usually have a holistic view of perceiving the environment (Bitner, 1992). This makes it difficult to estimate the effect of one factor in a larger context. In this study the customer seeing the lettuce prepared in the restaurant does not have a significant difference on product pleasantness. There are on-going research efforts to provide automated solutions to prepare lettuce. This study cannot yet verify whether technological solutions inside restaurants do or do not have an effect on product pleasantness. Further studies are still required to assess whether kitchen professionals preparing the lettuce is an adequate simulation of the context. Based on this study it appears that cutting the lettuce in the restaurant does not evoke either a negative or a positive response.

The sensory shelf life of minimally processed lettuce varies depending on whether it is related to the consumption or purchasing stage (Ares, Giménez, & Gámbaro, 2008). The study suggested that shelf life for purchasing is considerably shorter than for consumption (Ares, Giménez, & Gámbaro, 2008). This may suggest that people tend to decide at the moment of purchasing if the product is appealing enough to be consumed. When transferred into a foodservice context, it may indicate that products with unattractive appearance will be left untouched. When the product is already on the plate or 'bought' so to speak, some compromises on sensory quality are accepted. By serving lettuces or other vegetables with more attractive or fresh appearance, the rate of consumption could be increased.

Disconfirmation can be described as the difference between expected and perceived quality (Oliver, 1977; Oliver, 1980). When a product is better than expected, disconfirmation is positive, and when lower than expected then negative (Oliver, 1977; Oliver, 1980). In general, expectations formed beforehand do have an effect on product perception (Caporale & Monteleone, 2004; Piqueras-Fiszman & Spence, 2015). When

people visit the same restaurant frequently and are served packaged lettuce, they seem to settle for the quality served. When served a better than usual product, they do recognize the increased level of quality which can be seen as increased product liking. This indicates that there is hidden dissatisfaction towards the ready-to-eat lettuce. Creating positive disconfirmations may prove to be a valuable asset to restaurants. Previous studies have shown that positive disconfirmation resulted in increased customer satisfaction and loyalty (Ryu & Han, 2011) and also larger tips (Tse, 2003). It could be hypothesized that reward could also be seen as increased customer loyalty.

There some limitations to the study. Fresh and packaged lettuce samples were not from the same batch or manufacturer, the quality of interest was the rate of freshness between samples. The population sample had far more female respondents, which may have had an effect on the final results. In addition, the mean age of respondents was above average. The group of respondents represented the typical foodservice customers in the chosen locations. The average consumption of the lettuce could not be measured due to the experimental setting.

### **3 Conclusions**

This study indicates that consumers do recognize differences between ready-to-eat and freshly-cut lettuce when served in a foodservice environment. By serving fresh-cut products, the perceived level of sensory quality showed a significant increase. This indicated that by recognizing a fresh product consumer's experience positive disconfirmation when the quality is better than expected. Positive disconfirmation could be utilized to increase customer satisfaction in foodservice restaurants; thus increasing the consumption of vegetables in order to reach the recommended level. The food consumption context may have significant effect on food acceptance. In this study, the modification of the consumption context was the preparation of the lettuce in the restaurant. Based on this study it appears that preparing the lettuce in the restaurant does not evoke either negative or positive responses.

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