Parametric and non-parametric approach for sensory RATA (Rate-All-That-Apply) method of ledre profile attributes

S Hastuti1,2, Harijono2, E S Murtini2 and K Fibrianto2
1Faculty of Agriculture, Universitas Trunojoyo, Madura, Indonesia
2Department of Agricultural Product Technology, Faculty of Agricultural Technology, Universitas Brawijaya, Malang, Indonesia
E-mail: kiki.fibrianto@ub.ac.id

Abstract. This current study is aimed to investigate the use of parametric and non-parametric approach for sensory RATA (Rate-All-That-Apply) method. Ledre as Bojonegoro unique local food product was used as point of interest, in which 319 panelists were involved in the study. The result showed that ledre is characterized as easy-crushed texture, sticky in mouth, stingy sensation and easy to swallow. It has also strong banana flavour with brown in colour. Compared to eggroll and semprong, ledre has more variances in terms of taste as well the roll length. As RATA questionnaire is designed to collect categorical data, non-parametric approach is the common statistical procedure. However, similar results were also obtained as parametric approach, regardless the fact of non-normal distributed data. Thus, it suggests that parametric approach can be applicable for consumer study with large number of respondents, even though it may not satisfy the assumption of ANOVA (Analysis of Variances).

1. Introduction
Ledre is traditional food from Bojonegoro, East Java, Indonesia. Ledre made from batter mixture of rice flour, tapioca, sugar, coconut milk and banana. The other similar products with ledre is semprong and eggroll. Compared with semprong and eggroll, ledre has unique sensory. However, little is known about characteristic sensory of ledre. To address this paucity of information, this paper seeks to investigate the attributes sensory of ledre using the RATA method.

Profile attributes sensory of ledre can analyzed with RATA (rate-all-that-apply). RATA has the potential to improve sample description and discrimination [1]. Sensory product descriptions generated by consumers has triggered methodological in relation to sensory product characterization [2]. RATA allows panelist to rate the intensity of selected attributes with 3 intensities (low, medium and high) [3].

Non-parametric approach has some advantages, which can be used on small data and is free distribution [4]. Parametric approach must satisfy several assumptions such as normality, homogen, linear etc. [5]. Non-parametric can applied when certain assumptions cannot be made about the population. The Friedman test is a useful method of analysis for non-parametric data, especially in human competence research. In Friedman test, the answers of one respondent are ranked. Then all rankings of one competence are summed to gain group results [6]. Parametric (ANOVA), one other hands, incorporated means and variances to determine the test statistic. ANOVA is the most commonly technique for comparing means and it is important research reports.
For small data (n<30), the assumption of normality is particularly worrisome. Non-parametric generally have less power for the same sample than parametric if the data are normal [7]. It can be interesting study to use a parametric or non-parametric approach in some cases. As RATA questionnaire is designed to collect categorical data, non-parametric approach is the common statistical procedure but with the large number of panelists, it will be takes a long times and great effort. The objective of this research is comparison non-parametric and parametric approach for consumer study with RATA method.

2. Materials and Methods
2.1. Samples
There were 3 samples ledre with different ratio of rice flour and tapioca (Table 1.). Ledre was compared with semprong and eggroll. A total of 5 samples were produced in a home industry and represented standard recipes.

| Table 1. Ledre with ratio of rice flour and tapioca. |
|------------------------------------------------------|
| Ledre | Ratio rice flour : tapioca |
|-------|-----------------------------|
| Ledre A | 33 : 1 |
| Ledre B | 17 : 1 |
| Ledre C | 2 : 1 |

2.2. Panelist
The panelist was composed of 319 untrained panelist with 11 – 45 years of age. The task for the panelist consisted all the attributes, they perceived in the samples and evaluate their intensity on a 3-point scale with all points labeled (1 = “Low”, 2 = “Medium”, 3 = “High”).

2.3. Test procedures
During the sensory evaluations, samples (two pieces) were served in a transparent polypropylen (PP), labeled with a three digit code. The samples were stored at 15°C for 24 h and brought to room temperature (32°C) prior to serving. The samples were presented monadically in a randomized serving order according to a complete block design. Water was used as palate cleansers in between samples. The sensory attributes used in the study is listed in Table 2.

| Table 2. Overview of sensory attributes used in RATA. |
|------------------------------------------------------|
| Category | Attributes | Definitions |
|-----------|------------|-------------|
| Taste     | salty      | The taste of salt solution |
|           | Sweet taste| The taste of sugar solution |
| Texture   | Easy crack | Easy crack in the first bite |
|           | Easy-crushed | Easy broken from a whole to crumbles |
| Flavor    | Sweet flavor | The flavor of sugar solution |
|           | Banana flavor | The flavor of Musa textilis |
| Physic    | Brown color | Intensity of the red color observed in the surface of the ledre |
| Mouth-feel | Stingy sensation | The puncture on the tongue sensation |
|           | Solid sensation | Compact perception, described as “product remains as a whole”, |
|           | Greasy sensation | Rough and grainy perception in the mouth |
|           | Smoothness | Soft and velvety perception in the mouth |
|           | Dry | Crispy, resistance to flow before saliva modifies the sample |
|           | Sticky in mouth | The layer that remains in the mouth |
|           | Easy to swallow | - |
2.4. Data analysis
A mix of non-parametric and parametric statistical analyses were performed in order to address the aims outlined in the introduction. All analyses were performed using SPSS 16.0. Parametric test used analysis of variance (ANOVA) to know the significance and Fisher test to know the difference of 5 samples [8]. Non-parametric test used Friedman test to know the significance and Z test to know the difference of 5 samples. It is calculated as follows [4]:

\[
Z \left(1 - \frac{\alpha}{k(k-1)}\right) \sqrt{\frac{b(k+1)}{6}}
\]

where \(Z\) is probability, \(\alpha = 0.05\), \(k\) is the number samples and \(b\) is the number of panelists.

3. Results and discussion
The Friedman test showed that assymp.Sig. value was 0.000 (Table 3.). It means that there is significance different between 5 samples.

| Table 3. Friedman test. |
|-------------------------|
| N                      | 1595        |
| Chi-Square             | 3.757E3     |
| Df                     | 19          |
| Asymp.Sig              | .000        |

In non-parametric approach, the differences between samples were evaluated by Z value. The comparison was considered significant when the mean of rank difference is larger than critical Z value (112.2). In parametric approach, the different of samples can identified with Fisher test, which the different subscribe (a,b,c) is mean that there was a different between samples (Table 4.).

| Table 4. Non-parametric and parametric data comparison. |
|--------------------------------------------------------|
| No. | Attributes     | Easy-crused texture | Banana flavor | Brown color | Stingy sensation | Sticky in mouth | Easy to swallow | Roll lenght | Taste var | Roll length var | Easy-crack | Sweet flavor | Dry | Solid sensation | Sweet taste | Smooth texture | Salty | Greasy sensation | Form var | Packaging var | Form packaging var |
|-----|----------------|---------------------|---------------|-------------|-----------------|-----------------|-----------------|-------------|-----------|-----------------|------------|--------------|-----|-----------------|-------------|-----------------|-------|-----------------|----------|---------------|-------------------|
| 1   | Easy-crused texture | 79                  | 83.5          | 4.5         | 2.19            | 2.22            | 2.33            |
| 2   | Banana flavor    | 11                  | 44            | 33          | 2.29            | 2.30            | 2.37            |
| 3   | Brown color      | 196.5               | 339.5         | 143         | 1.44            | 1.75            | 1.97            |
| 4   | Stingy sensation | 23                  | 30            | 53          | 1.91            | 1.94            | 2.02            |
| 5   | Sticky in mouth  | 36                  | 73            | 109         | 1.69            | 1.80            | 1.86            |
| 6   | Easy to swallow  | 34                  | 18            | 16          | 2.24            | 2.28            | 2.30            |
| 7   | Roll lenght      | 12                  | 321           | 309         | 2.14            | 2.15            | 2.65            |
| 8   | Taste var        | 35                  | 20            | 55          | 2.13            | 2.18            | 2.20            |
| 9   | Roll length var  | 7                   | 209           | 216         | 2.08            | 2.09            | 2.42            |
| 10  | Easy-crack       | 89                  | 153.5         | 64.5        | 2.34            | 2.20            | 2.09            |
| 11  | Sweet flavor     | 74                  | 56            | 130         | 2.17            | 2.05            | 2.29            |
| 12  | Dry              | 120                 | 153           | 33          | 2.48            | 2.28            | 2.24            |
| 13  | Solid sensation  | 59                  | 35            | 24          | 1.77            | 1.83            | 1.85            |
| 14  | Sweet taste      | 90                  | 47            | 137         | 2.29            | 2.16            | 2.39            |
| 15  | Smooth texture   | 76                  | 106           | 30          | 2.22            | 2.08            | 2.01            |
| 16  | Salty            | 27                  | 24            | 51          | 1.32            | 1.36            | 1.29            |
| 17  | Greasy sensation | 8                   | 33            | 41          | 1.32            | 1.37            | 1.29            |
| 18  | Form var         | 14                  | 7             | 21          | 1.83            | 1.83            | 1.84            |
| 19  | Packaging var    | 0                   | 44            | 44          | 1.85            | 1.83            | 1.89            |
| 20  | Form packaging var | 31              | 21           | 10          | 1.76            | 1.79            | 1.78            |

Note: a,b,c is showed significant at P<0.05
The rate attribute easy-crushed texture of ledre A, B and C below the Z value, it mean that there wasn’t different between ledre A,B and C. In parametric approach, it also no different between ledre A,B and C showed with the same subscribe between 3 samples. The similar result showed in attributes brown color, the non-parametric and parametric approach showed the similar result. Three samples showed significant different (P<0.05) in brown color attributes.

It suggests that parametric approach can be applicable to stand in non-parametric condition, eventhough it may not satisfy the assumption of ANOVA (Asymp.Sig 2-tailed/ normality all attributes was 0.000). Normality test with Kolmogorov-Smornov is that if the significance below 0.05 means the data is not normal [5].

Table 5 shows that ledre is characterized as easy-crushed texture, sticky in mouth, stingy sensation and easy to swallow. It has also strong banana flavour with brown in colour. Compared to eggroll and semprong, ledre has more variances in terms of taste as well the roll length.

| No | Attributes           | Semprong | Ledre   | Eggroll |
|----|----------------------|----------|---------|---------|
| 1  | Easy-crused texture  | Low      | medium  | high    |
| 2  | Banana flavor        | low      | high    | Low     |
| 3  | Brown color          | high     | medium  | Low     |
| 4  | Stingy sensation     | Low      | medium  | Low     |
| 5  | Sticky in mouth      | Low      | medium  | Low     |
| 6  | Easy to swallow      | Low      | medium  | high    |
| 7  | Roll length          | Low      | High    | Low     |
| 8  | Taste var            | Low      | High    | Low     |
| 9  | Roll length var      | low      | high    | Low     |

Note: Low : 1 – 1.49; Medium: 1.5 – 2.49; High : 2.5 – 3

4. Conclusion
Based on comparison of parametric and non-parametric data processing, it is concluded that parametric approach can be applicable for consumer study with large number of respondents, even though it may not satisfy the assumption of ANOVA.

References
[1] Meyners M, Jaeger S R, Ares G 2016 On the analysis of Rate-All-That-Apply (RATA) data. Food Qual Prefer 49 1–10
[2] Varela P, Ares G 2012 Sensory profiling, the blurred line between sensory and consumer science. A review of novel methods for product characterization Food Res International 48 893–908
[3] Ares G, Bruzzone F, Vidal L, Cadena R S, Giménez A, Pineau B, Hunter D C, Paisley A G, Jaeger S R 2014 Evaluation of a rating-based variant of check-all-that-apply questions: Rate-all-that-apply (RATA) Food Qual Prefer 36 87–95
[4] Sprent P, Smeeton N C 2007 Applied Nonparametric Statistical Methods Chapman and Hall London 30-254
[5] Riduwan 2016 Dasar-dasar Statistika Alfabeta Bandung Indonesia 183-184 [In Indonesian]
[6] Daniel W W 1991 Statistik Nonparametrik Terapan. Gramedia Jakarta Indonesia 187-265 [In Indonesian]
[7] Kaur A, Kumar R 2015 Comparative analysis of Parametric and Non-parametric Test Journal of Computer and Mathematical Sciences 6 6 336-342
[8] Suwarwenedi W 2015 SPSS untuk penelitian Penerbit Pustaka Baru Press Yogyakarta Indonesia 97-109 [In Indonesian]