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EFFECT OF FERMENTATION TIME AND LEAVENING AGENT ON THE QUALITY OF LABORATORY PRODUCED AND MARKET SAMPLES OF *MASA* (A LOCAL CEREAL BASED PUFF BATTER)

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ABSTRACT

Evaluation of production techniques, quality of market samples and effects of fermentation times (6 and 8hrs), leavening agents (yeasts and baking powder) and shelf life (fresh and 24h) on the quality of *masa* were carried out through interviews, processing operations, laboratory analyses and sensory studies. Statistical analyses were carried out using the SPSS Statistical Package. Variations in processing techniques among *masa* producers were method of preparing the rice, soaking time for the rice (4 – 6h), the time paste was allowed to stay before baker's yeast was added (3 – 4h), frying time (4 -5 minutes) and ratios of cooked rice to soaked rice (1: 2 and 1: 4). Uniform practices among *masa* producers were washing, wet-milling, fermentation time (overnight), addition of yeast, salts and sugars and dilution of fairly thick batter with *trona* (baking powder) before frying. Functional properties of rice were foam capacity (23.7%), foam stability (88.5%), water absorption capacity (0.02%), gelation capacity (20%), gelatinization temperature (82^{o}C) and gelation time (20 minutes) Significant differences were observed between the *masa* samples for ash, moisture, protein, lipid and total bacterial counts ($p \leq 0.05$). Their ranges for both laboratory-processed and market samples, respectively were; moisture (10.2 – 11.7% and 12.0 – 13.7%); protein (7.1 – 7.6% and 7.6 – 8.2%); lipid (1.9 – 2.4% and 2.4 – 2.6%); ash (0.4 – 0.7% and 0.6 – 0.8%) and total bacterial counts (1.2×10^1 – 1.6×10^1 cfu/g). For the first day of their production, significant differences ($p \leq 0.05$) were observed for all the sensory factors for both laboratory-processed and market samples of *masa*. Based on sensory scores, all the laboratory-produced *masa* samples were organoleptically acceptable without much significant difference ($p \geq 0.05$) except for *masa* fermented for 8h without leavening agent. The mean sensory scores of all fresh market samples of *masa* were less than 4.0 on a 7-point Hedonic scale. Significant differences were observed between the market and laboratory processed samples of *masa* after the first day of production for all the sensory factors ($P \leq 0.05$) and 50% of market and laboratory produced *masa* samples were not sensorially acceptable. Unlike freshly produced (for both market and laboratory) *masa* samples, it was found out that after the first day (24h) of production, the trend was not the same. This is because unlike market samples of *masa*, laboratory prepared *masa* samples without leavening agents, were as unacceptable as *masa* samples with leavening agents.

Key words: *Masa,* quality, Fermentation, Leavening, processing

INTRODUCTION

Masa or *waina* is a fermented puff batter made of Rice, Maize or Millet cooked in a pan with individual cuplike depressions. It is a popular staple food consumed by over 80% of Northern Nigeria population and is also consumed in Niger, Burkina Faso and Mali. *Masa* is prepared to create variety in cereals for sale and it serves as a breakfast and snacks item [1]. The different types of cereal grain (rice, maize and millet) used for *masa* production have been reported to have different effects on physical aspects of *masa* such as thickness, length, weight, volume and volume index [2].

Majority of traditional cereal based foods consumed in Africa are processed by natural fermentation and are particularly important as weaning foods for infants and as staples [3]. Functions of fermentation in traditionally foods are detoxification, development of diversity flavours, aroma and textures. Others are nutritional improvement and preservation of substantial amounts of food through lactic acid, alcohol, acetic and alkaline fermentations [4]. Souring of dough has been linked to lactic acid fermentation during which lactic acid and other organic acids are produced [5]. Pre-fermentation treatments of cereals are largely dependent on the type of cereal and on the end product desired. Generally, treatments such as drying, washing, steeping, milling, and sieving are some of the processing steps applied in the preparation of these fermented cereal foods [6].

Previous work on *masa* production seemed to suggest that techniques of production varied among different peoples and places [2]. This implies that the problems of *masa* include the inconsistency in the use of variety of cereals and spices. These have resulted in variations in the quality of the product. There is also the problem of differences in the processing techniques especially the non-uniform fermentation times and type/quantities of leavening agents. As a result of the above, this research was therefore geared towards the study of the production techniques carried out by commercial producers and to evaluate and compare the quality of market sample and laboratory produced samples of *masa*. This research also evaluated the shelf life of *masa* as well as finding out the effect of fermentation time and leavening agent on the quality of *masa* for the day of production and 24h after production.

MATERIALS AND METHODS

Procurement of Raw materials

The raw materials that were used included: Rice, baking powder, yeast, salt, sugar, and vegetable oil and were purchased at Jimeta Modern Market, Adamawa State, Nigeria. Four different market samples of *masa*: MAA, MBB, MCC and MDD were bought from commercial centre of Modibo Adama University of Technology (MAUTECH), Yola, Nigeria.

Research design

Interviews were conducted with producers of *masa* who sell their products at the commercial centre of Modibo Adama University of Technology (MAUTECH), Yola.

The research design was a 2x3x2 factorial experiment resulting in sample treatments shown in table 1. The main factors were fermentation time (6 h and 8 h) while the sub-factor were leavening agents (yeast, combination of baking powder and yeast, and neither yeast nor baking powder) and the sub-sub-factor was shelf-life (day 1 and day 2). The symbols for the factors are shown in Table 1.

Processing operations

Five hundred grams (500 g) of rice was washed and a quarter of it (125 g) was taken and cooked. The remaining three-quarters (375 g) of the rice was soaked for six hours. Then, the 125 g cooked rice was mixed with the 375 g soaked rice and was wet-milled into a fine paste. The paste was divided into six portions. Sugar (5 g) and salt (30 g) were added to each portion and mixed. Depending on the research design, either 0.5 g of yeast alone or 0.25 g each of yeast and baking powder or neither yeast nor baking powder were added to only a portion before frying separately in a cup-pan. They were evaluated on the day of production (d_1) and one day after production d_2). The processing flowchart is shown in Figure 1.

Proximate composition, functional and sensory properties analyses

Proximate composition determinations were moisture (hot-air-oven), lipid (soxhlet), ash (muffle furnace) and protein (Kjedahl) [7] while total bacterial content was determined using the pour plate method [8]. Functional properties of rice grains, (the major raw material used for *masa* production) were water absorption capacity [9], foam capacity and stability [10], gelling temperature, gelation capacity and loaf volume was also analyzed [9]. Sensory factors evaluated were taste, flavour, appearance, colour, mouth feel, softness, and acceptability. They were rated on a seven-point Hedonic scale where 1 = liked very much and 7 = dislike very much. The results obtained were subjected to analysis of variance followed by Duncan's multiple range difference tests for mean separation.

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Rice
↓
Cleaning
↓
Washing
↓
Cooked Rice (25%) | Rice soaked for 6 hours (75%)
↓
Mixing with leavening agents
↓
Wet-milling
↓
Fermentation (6 h & 8 h)
↓
Mixing with spices and sugar
↓
Frying
↓
Masa with a golden brown colour

Figure 1: Flow chart of processing of *Masa.*

RESULTS

Results of the Field Study

Interviews conducted with five *masa* producers/sellers at the commercial centre of Modibo Adama University of Technology (MAUTECH), Yola showed that the raw materials for production were rice, millet, salt, sugar, baking powder, yeast, *trona* or *kanwa* and vegetable oil. Among the five interviewed *masa* producers, four producers used only rice while one producer used rice and millet.

Functional properties

Results of functional properties of rice used for preparing *masa* gave foam capacity (23.7%), foam stability (88.5%), water absorption capacity (0.02%), gelation capacity (20%) and gelatinization temperature (82^{oC}) while gelation time was 20 minutes.

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Proximate Composition and Microbial loads of samples of *masa*

The percentage moisture, lipid, protein and ash compositions and total bacterial load of market samples and laboratory-produced *masa* samples are shown in table 2. Significant differences were observed for each of the proximate values ($p \leq 0.05$). The percentage moisture content ranged from 10.2% for laboratory produced *masa* that is fermented for 6h without leavening agent ($FT_1LV_3d_1$) to 13.5% of first market sample of *masa* on the first day of production ($MAAd_1$). Also the protein contents ranged from 7.0% of *masa* fermented for 6h no leavening agent day 1 to 8.2% for first market sample of *masa* on the first day of production ($MAAd_1$). The percentage fat composition ranged from 1.9% to 2.6% while that of ash ranged from 0.4% to 0.8%.

Acceptability test of market and laboratory produced samples of *masa*

Table.3 gives the mean sensory scores for laboratory-processed *masa* and market samples of *masa* on the first day of their production whereas table 4 shows the sensory scores of the samples for 24h after production.

DISCUSSION

Production process

The processing technique varied among *masa* producers. The method of preparing the rice for *masa* production also varied among the different masa producers. Production techniques, types of grains used and ratio of these grains to one another varied when compared to previous works [1, 2]. For example, among the five (5) interviewed *masa* producers, three (3) used both cooked and soaked rice together while the other two used only soaked rice. Soaking time for the rice varied between 4 – 6 hours while the time the paste was allowed to stay before baker’s yeast was added, varied between 3 – 4 hours. Frying time varied between 4 - 5 minutes while the ratio of cooked rice to soaked rice varied between 25% to 75% and 50% to 50%, respectively. The uniform practices among the producers were washing, wet-milling, fermentation time (overnight), addition of yeast, salts, sugars, and also-dilution of fairly thick batter with *trona* (baking powder) before frying.

Functional properties

The foaming capacity indicated the rising capacity of the rice flour while foam stability shows how long the flour can hold air. The water absorption capacity gave an insight into the ability of the rice to imbibe water in the dough mix. Gelation is an aggregation of denatured molecules. This is the concentration of rice that will gel without being scattered. Gelation time showed that for 20 minutes at 82^{o}C, that the rice was well cooked. The results imply that rice flour has a higher tendency for gel formation [6, 9]. The functional properties of the flour have shown the potential for industrial applications of the flour particularly in the food systems such as *masa* that require thickening and gelling. The percentage moisture, lipid, protein and ash and total bacterial load of market samples and laboratory-produced *masa* samples are shown in Table 2.

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Proximate composition and microbiological analyses
Significant differences were observed among the samples for all the components of the *masa* samples. The moisture content of market sample was higher than the laboratory produced *masa* samples, which implies that they are more prone to spoilage. This was supported by the high microbial loads of the market samples when compared to the laboratory processed samples. It was observed from table 2 that there is lack of uniformity in the market samples as compared to the laboratory processed *masa* samples.

Sensory analysis
For the laboratory-processed *masa* samples, all the sensory scores were less than 4.0 (neither liked nor disliked) on a seven-point Hedonic scale except for flavor and general acceptability for sample FT_2LV_3. Fermentation times and leavening agents were found to affect the organoleptic acceptability of *masa* samples as significant differences ($p \leq 0.05$) were observed for all the sensory factors except texture, for example finger-feel and mouth-feel.

From the results of general acceptability, it was observed that *masa* prepared without a leavening agent was only significantly different ($p \leq 0.05$) from other *masa* treatments at 8 hours of fermentation ($FT_2LV_3d_1$) and not at 6 hours of fermentation ($FT_1LV_3d_1$.). Also, the *masa* fermented for 8 hours without leavening agent ($FT_2LV_3d_1$) were the least organoleptically accepted samples on all sensory factors based on numerical rating. In conclusion, all the treatments except ($FT_2LV_3d_1$) produced *masa* samples that were organoleptically acceptable.

Table 3 also gives the mean sensory scores of all the market samples of *masa* on the first day of their production. All the sensory scores were less than 4.0 on a seven-point Hedonic scale. Scores less than 4.0 on a 7-point Hedonic scale implied that all the market samples of *masa* were very much acceptable to the semi-trained panelists irrespective of the source of procurement. Significant differences ($p \leq 0.05$) were observed for only finger-feel and taste. In general, *masa* samples MCC and MDD were most acceptable by the taste-panelists.

Table 4 shows the sensory scores of the market and laboratory-processed *masa* samples after the first day of production. General deterioration on the organoleptic acceptability of both market and laboratory produced *masa* samples were observed after the first day of production. For the laboratory prepared samples, only treatment samples $FT_1LV_2d_2$, $FT_1LV_3d_2$ and $FT_2LV_3d_2$ were still acceptable since their "general acceptability" rating were still less than 4.0 on a 7-point scale. The sensory scores of the rest of the laboratory-prepared samples were above 5.0. As for the market samples of *masa*, samples $MAAd_2$ (6.00) and $MDDd_2$ (4.50) had shown more signs of dislike after the first day of production when compared to the rest of the samples.

Significant differences were observed between the market and laboratory processed samples of *masa* for all the sensory factors ($p \leq 0.05$). Unlike for fresh samples of *masa* (table 3), it was found out that after the first day of production, laboratory

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prepared samples without leavening agents, $FT_2LV_3d_2$ (5.75) were as unacceptable as samples with leavening agents $FT_1LV_1d_2$ (6.00), $FT_2LV_1d_2$ (5.25) and $MAAd_2$ (6.00). In general, the effect of fermentation time and leavening agent on the acceptability of *masa* samples were not definite after twenty four of production as shown by their mean sensory scores. Also the market samples of *masa* did not show similar defined variations in the sensory factors as for the fresh samples.

CONCLUSION AND RECOMMENDATIONS

Findings have shown that the raw materials for *masa* production were rice, millet, salt, sugar, baking powder, yeast, *trona* or *kanwa* and vegetable oil. Rice was found to be most popular raw material used in production of *masa*. The ratios of cooked rice to uncooked rice before milling were 1: 4 and 1: 2 with the latter being more popular.

In general, *masa* production technique varied among the different producers. This was also reflected in the non-uniformity of the market samples as reflected in the results of their proximate composition and sensory evaluations. Based on sensory analysis, the effects of leavening agents and fermentation times were observed much more on the first day of production than on the second day of production. Though *masa* sample of 8h fermentation time with yeast as leavening agent was found to be most acceptable, findings have shown that fermentation time could be reduced to 6h as against over 12h local processors ferment their dough. Finally, shelf life of *masa* for most of the treatments is about forty eight hours.

Higher quantities of either yeast or *trona* or both is hereby recommended for leavening as this could reduce fermentation time as well as yield dough with preferred attributes. Additionally, different ratios of cooked rice to uncooked rice should be explored to find out the 'best' ratio for a more acceptable *masa* product.

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Table 1: Codes and descriptions of self-processed masa for day 1 and 2

S/no	Codes	Descriptions
1.	$FT_1LV_1d_1$	Fermented for 6hours, leavened with yeast –day 1.
2.	$FT_1LV_2d_1$	Fermented for 6hours, leavened with baking powder and yeast –day 1.
3.	$FT_1LV_3d_1$	Fermented for 6hours no leavened agent –day 1..
4.	$FT_2LV_1d_1$	Fermented for 8hours and leavened with yeast –day 1.
5.	$FT_2LV_2d_1$	Fermented for 8hours, leavened with baking powder and yeast –day 1.
6.	$FT_2LV_3d_1$	Fermented for 8hours no leavened agent –day 1.
7.	$FT_1LV_1d_2$	Fermented for 6hours and leavened with yeast –day 2.
8.	$FT_1LV_2d_2$	Fermented for 6hours, leavened with baking powder and yeast –day 2.
9.	$FT_1LV_3d_2$	Fermented for 6hours no leavened agent –day 2.
10.	$FT_2LV_1d_2$	Fermented for 8hours, leavening agent –day 2.
11.	$FT_2LV_2d_2$	Fermented for 8hours, leavened with baking powder and yeast –day 2.
12.	$FT_2LV_3d_2$	Fermented for 8hours no leavened agent –day 2.
13.	$MAAd_1$	First Market sample of masa on day 1 of production
14.	$MBBd_1$	Second Market sample of masa on day 1 of production
15.	$MCCd_1$	Third Market sample of masa on day 1 of production
16.	$MDDd_1$	Fourth Market sample of masa on day 1 of production
17.	$MAAd_2$	First Market sample of masa on day 2 of production
18.	$MBBd_2$	Second Market sample of masa on day 2 of production
19.	$MCCd_2$	Third Market sample of masa on day 2 of production
20.	$MDDd_2$	Fourth Market sample of masa on day 2 of production

NB:

- Fermentation times: (FT_1 = 6h and FT_2 = 8h)
- Leavening agents: (LV_1 = yeast; LV_2 = Yeast and baking powder; LV_3 = none added)
- Shelf-lives: (d_1 = day of production and d_2 = 24h shelf-life).
- Quantity of yeast used was: 0.5g.
- Quantity of baking powder used (0.25g) and yeast (0.25g) when combined.
- Quantity of sugar used was 5g.

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Table 2: Percentage moisture, protein, ash and lipid content and total plate count of laboratory-processed and market samples of *masa* for day of production (d_1)

S/N	Sample	Moisture	Protein	Fat	Ash	TPC
1.	$MAAd_1$	13.5 ± 0.10^c	8.2 ± 0.20^d	2.5 ± 0.10^{bc}	0.8 ± 0.18^b	$7.6x10^1$
2.	$MBBd_1$	12.0 ± 0.50^b	7.8 ± 0.360^{bc}	2.4 ± 0.10^{bc}	0.6 ± 0.10^{ab}	$5.4 * 10^1$
3.	$MCCd_1$	12.0 ± 0.50^b	7.6 ± 0.10^c	2.4 ± 0.20^{bc}	0.6 ± 0.12^{ab}	$4.0 * 10^1$
4.	$MDDd_1$	13.7 ± 0.20^c	7.9 ± 0.41^c	2.6 ± 0.20^c	0.8 ± 0.15^{ab}	$7.8 * 10^1$
5.	$FT_1LV_1d_1$	11.5 ± 0.30^b	7.3 ± 0.30^{abc}	2.3 ± 0.20^{bc}	0.5 ± 0.10^{ab}	$1.3 * 10^1$
6.	$FT_1LV_2d_1$	11.7 ± 0.20^b	7.4 ± 0.20^{abc}	2.4 ± 0.20^{bc}	0.6 ± 0.10^{ab}	$1.5 * 10^1$
7.	$FT_1LV_3d_1$	10.2 ± 0.20^a	7.0 ± 0.10^a	1.9 ± 0.10^a	0.4 ± 0.19^a	$1.2 * 10^1$
8.	$FT_2LV_1d_1$	11.6 ± 0.10^b	7.3 ± 0.20^{abc}	2.2 ± 0.20^b	0.5 ± 0.15^{ab}	$1.4 * 10^1$
9.	$FT_2LV_2d_1$	11.8 ± 0.30^b	7.6 ± 0.20^c	2.4 ± 0.10^{bc}	0.7 ± 0.10^{ab}	$1.3 * 10^1$
10	$FT_2LV_3d_1$	10.5 ± 0.40^a	7.1 ± 0.10^{ab}	1.9 ± 0.20^a	0.4 ± 0.10^a	$1.6 * 10^1$

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Table 3: Mean Sensory scores of laboratory-produced and market samples of *masa* on day one of production (fresh *masa* samples)

Sno	Samples	Flavour	Appearance	Taste	Colour	Mouth-feel	Finger-feel	Gen. Acceptability
1	$FT_1LV_1d_1$	2.11 ± 1.15^{a}	3.37 ± 1.46^{c}	2.32 ± 1.16^{ab}	3.26 ± 1.24^{bc}	2.79 ± 1.58^{abc}	2.84 ± 1.61^{ab}	2.82 ± 1.07^{a}
2	$FT_1LV_2d_1$	3.37 ± 1.17^{bcd}	1.84 ± 0.83^{a}	3.68 ± 1.16^{cd}	2.11 ± 1.05^{a}	3.47 ± 1.17^{bc}	3.37 ± 1.77^{b}	3.00 ± 0.82^{a}
3	$FT_1LV_3d_1$	3.95 ± 1.43^{cd}	2.00 ± 1.16^{a}	3.42 ± 1.39^{cd}	2.21 ± 0.98^{a}	3.26 ± 1.59^{abc}	3.58 ± 1.64^{b}	3.21 ± 1.08^{ab}
4	$FT_2LV_1d_1$	3.21 ± 1.62^{bcd}	2.58 ± 1.22^{abc}	3.13 ± 1.63^{bcd}	3.05 ± 1.43^{abc}	3.16 ± 1.42^{abc}	3.42 ± 1.22^{b}	3.21 ± 0.98^{ab}
5.	$FT_2LV_2d_1$	2.95 ± 1.62^{abc}	3.00 ± 1.37^{bc}	3.32 ± 1.67^{bcd}	3.26 ± 1.28^{bc}	2.95 ± 1.18^{abc}	2.90 ± 1.45^{ab}	3.11 ± 0.94^{a}
6.	$FT_2LV_3d_1$	4.00 ± 1.83^{d}	3.74 ± 1.56^{d}	3.74 ± 1.56^{d}	3.95 ± 1.47^{c}	3.53 ± 1.35^{c}	3.53 ± 1.53^{b}	4.00 ± 1.45^{b}
7.	$MAAd_1$	2.89 ± 1.49^{ab}	3.00 ± 1.37^{bc}	3.00 ± 1.24^{abcd}	2.89 ± 1.45^{ab}	2.89 ± 1.28^{abc}	3.44 ± 1.72^{b}	3.22 ± 1.35^{ab}
8.	$MBBd_1$	2.89 ± 1.45^{ab}	2.44 ± 1.29^{abc}	3.11 ± 1.45^{bcd}	2.78 ± 1.11^{ab}	2.39 ± 1.04^{a}	2.17 ± 0.99^{a}	2.67 ± 1.03^{a}
9.	$MCCd_1$	1.94 ± 0.87^{a}	2.33 ± 1.03^{ab}	2.06 ± 1.43^{a}	2.78 ± 1.31^{ab}	2.33 ± 1.03^{a}	2.11 ± 0.96^{a}	2.61 ± 1.46^{a}
10.	$MDDd_1$	2.72 ± 1.53^{ab}	2.72 ± 1.53^{abc}	2.67 ± 1.28^{abc}	2.44 ± 1.76^{ab}	2.50 ± 1.34^{ab}	2.50 ± 1.38^{ab}	2.61 ± 0.98^{a}

NB:

- Figures are means of 18 taste-panelists ± S.E
- Figures in the same column with same or no superscript(s) are significantly not different from each other ($P \geq 0.05$)
- Treatment symbols are explained in table 1 page 4

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Table 4: Mean Sensory scores of laboratory-produced and market samples of masa after first day of production (> 24h shelf – life)

Sno	Samples	Flavour	Appearance	Taste	Colour	Mouth-feel	Finger-feel	Gen. Acceptability
1.	$FT_1LV_1d_2$	5.50 ± 0.58^{b}	5.75 ± 0.96^{c}	5.75 ± 0.96^{c}	4.75 ± 0.50^{cd}	6.00 ± 1.15^{b}	6.25 ± 0.96^{c}	6.00 ± 0.82^{c}
2.	$FT_1LV_2d_2$	3.50 ± 0.58^{a}	2.00 ± 1.15^{a}	3.50 ± 0.58^{ab}	2.75 ± 0.96^{ab}	3.25 ± 1.26^{a}	3.75 ± 0.96^{ab}	$2.75 \pm 0.96a$
3.	$FT_1LV_3d_2$	3.25 ± 0.96^{a}	3.00 ± 0.82^{a}	3.75 ± 0.50^{ab}	3.75 ± 0.96^{abc}	4.25 ± 1.26^{ab}	4.50 ± 0.58^{abc}	3.75 ± 0.50^{ab}
4.	$FT_2LV_1d_2$	3.75 ± 1.50^{a}	3.00 ± 1.41^{a}	2.75 ± 0.96^{a}	4.00 ± 0.82^{bc}	4.50 ± 0.58^{ab}	5.25 ± 0.50^{bc}	5.25 ± 0.50^{c}
5.	$FT_2LV_2d_2$	3.25 ± 0.50^{a}	2.75 ± 0.50^{a}	3.50 ± 0.58^{ab}	3.00 ± 0.82^{abc}	4.25 ± 1.26^{ab}	4.00 ± 0.82^{ab}	3.00 ± 0.82^{ab}
6.	$FT_2LV_3d_2$	6.00 ± 0.82^{b}	5.00 ± 0.82^{bc}	5.50 ± 0.58^{c}	6.00 ± 0.82^{d}	6.00 ± 0.82^{b}	6.00 ± 0.82^{c}	5.75 ± 0.96^{c}
7.	$MAAd_2$	5.50 ± 0.58^{b}	5.50 ± 1.00^{c}	5.75 ± 0.96^{c}	4.50 ± 1.00^{bcd}	6.00 ± 1.15^{b}	6.25 ± 0.96^{c}	6.00 ± 0.82^{c}
8.	$MBBd_2$	3.50 ± 0.58^{a}	1.75 ± 0.96^{a}	3.58 ± 0.58^{ab}	2.00 ± 1.41^{a}	3.50 ± 1.29^{a}	3.50 ± 1.29^{ab}	2.75 ± 0.96^{ab}
9.	$MCCd_2$	3.25 ± 0.96^{a}	2.75 ± 0.50^{a}	2.75 ± 1.26^{a}	3.75 ± 0.96^{abc}	3.75 ± 1.71^{a}	3.00 ± 1.83^{a}	3.50 ± 1.00^{ab}
10.	$MDDd_2$	3.50 ± 1.73^{a}	3.50 ± 1.38^{ab}	4.50 ± 2.08^{bc}	4.00 ± 1.16^{bc}	4.25 ± 0.96^{ab}	4.75 ± 0.96^{abc}	4.50 ± 0.73^{b}

- Figures are means of 18 taste-panelists ± S.E
- Figures in the same column with same or no superscript(s) are significantly not different from each other ($P \geq 0.05$)
- Treatment symbols are explained in table 1 page 4

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