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Sensory evaluation of wheat bread made with wild yeast and its mutant species isolated from fermented orange juice.

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----------ABSTRACT----------
The aim of the work was to evaluate the sensory properties of wheat bread made with wild yeast (Kodamae ohmeri, Geotrichum capitatum) and its mutant species and to find out consumers acceptance of the new product. The main sensory properties (colour of the bread crumb, texture, aroma) were evaluated with a hedonic scale of 1 (lowest) to 5 (highest), which was used for the determination of the degree of acceptance. The sensory data were analysed by means of the analysis of variance (Anova). Quality evaluation of the sweetened and unsweetened breads made with the wild yeast and its mutant revealed that the mutant species showed better quality than their wild type, with regard to their texture and their organoleptic properties; mutants of nitrous acid sweetened and unsweetened bread samples; DS20 was the best with a mean value of (4.25^a, 4.00^a), followed by 7F9 (4.00^a, 3.50^a), DS6 and 7F8 (3.75^a, 3.75^a). For the mutants of U.V. light the following bread samples were ranked the best at different mutation time. At 15minutes, DS6 (3.86^a, 4.15^a), at 20minutes, DS10 (4.15^a, 4.00^a), at 25 minutes, DS14 (4.29^a, 3.86^a) and at 30minutes, (DS14 (3.71^a, 3.63^a). The results of the hedonic rating also proved that the panelist preferred the wheat bread made with the mutant species in the sweetened bakery product and the bread samples made with the wild yeast in the unsweetened bread. The results of the analysis of variance showed that there is no significant difference in the colour and aroma of the bread samples with the wild yeast and its mutant species when compared with the control sample baked with the commercial baker's yeast.

KEYWORDS: *Geotrichum capitatum, Kodamae ohmeri, baker's yeast, bread samples, texture, sensory evaluation.*

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I. INTRODUCTION

Bread is consumed world wide with variety types, acceptable to both children and adult and it plays an important food (Onuegbo *et al*; 2007). Bread making is fundamentally a temperature dependent two step progression, consisting of fermentation, in which $C0_2$ production linked with yeast activity is manifested in porous dough structure with the development of dough volume during baking where yeast activity is ended and the bread structure is finalised. During baking, the inside temperature reaches 100^0C and the volume fraction of bread reaches a final value between 0.8 and 0.9 (Shehzad *et al*., 2010; Shehzad *et al*., 2011), while gluten cross-links and starch granules are disrupted (Franci and Igore, 2011). The concluding bread structure depends on dough ingredients, yeast activity, fermentation temperature, and gas bubble formation (Ali, *et al*., 2012). Many types of breads are baked with yeast. The most commonly used in baking as a leavening agent is *Saccharomyces cerevisiae*, the same species used for brewing alcoholic beverages. Additionally, *Saccharomyces exigus* (also known as *S. minor*) is wild yeast on plants, fruits and grains that is occasionally used for baking . When yeast is used for making bread, it is mixed with flour, salt and warm water (or milk). The dough is kneaded until it is smooth and then left to rise, sometimes until it has doubled in size. The dough is shaped into loaves and baked to produce the final product.

In bread manufacture, there are three sources of fermentable sugars. First, there is the sugar present in dough at the start of the bread-making process (including glucose, fructose, sucrose and maltose naturally present in the flour) and secondly, any fermentable sugars such as sucrose added by the baker. The amount of fermentable sugar added by the baker varies, but can reach up to 25% w/w in some sweet dough (Nagodawithana and Trivedi, 1990). The third source of sugar is maltose produced by the amylolytic breakdown of starch (Evans, 1990).The sensory quality of food products plays an important role in the choice of food. Hedonic testing is often used to determine consumer's attitudes towards acceptance of a new or improving the existing food product (Meilgard, *et al*., 1991).

Today, baker's yeast is used for bread manufacturing through out the world at industrial scale. With the improvement of bread industry, the use of starter culture increased tremendously. At present, the bread industry of Pakistan is solely dependent upon the import of yeast. The ability to produce bread with yeast other than the species of *Saccharomyces* in our environment is still a quest that needs to be considered. Thus, there is need to exploit other sources of yeast through modification which can be done through mutation processes. This work was under taken to evaluate the sensory properties of wheat bread made with wild and its mutant species from fermented orange juice and to ascertain consumer's acceptance of the new product.

II. MATERIALS AND METHODS

Sample collection and bread making process

The yeast strains of *Kodamae ohmeri*, (2F36) *Geotrichum capitatum* (7F9) *Candida norvegensis* (7F8), *Candida zeylanoides* (DS10 and 20) and *Rhodotorula minuta* (DS6), used in this study were obtained from fermented single-strength orange juice from sound and defective orange fruit. The yeast strains were modified through mutation techniques by the use of nitrous acid and ultra violet light. These mutants were used in bread making because of its high fermentative capacity.Fifty (50 g) wheat flour basis consisting of instant dry yeast 1.5% (baker's yeast), salt 1% and vegetable oil 1% (Brookline, 2004). All were purchased from the market in Zaria, Kaduna state. The laboratory wild creamy and mutant yeast 1.5% siphoned from the growth medium was used for the fermentation of the dough. The ingredients were mixed, the dough mixture for the samples were individually poured into a 250ml measuring cylinders. The dough was fermented at 27 ± 1^0C for proofing for three, twenty-four and forty-eight hours interval in a fermentation cabinet (incubator) bread dough loaves were baked for 45 minutes at 18^0C in a hot air oven. The bread was cooled to 27 ± 1^0C for 1 hour after baking, then placed in polyethylene bag and stored at, 27 ± 1^0C for 18-24 hours before sensory evaluation.

Consumer panel sensory evaluation : The sensory quality of the bread was analysed using a 30-semi-trained consumer panelists using the approved AACC (American Association of Cereal Chemists, 2000) method. The panelists received encoded samples and questionnaires as well as instruction for the evaluation of the samples. Panelists used hedonic scale of 1 (lowest) to 5 (highest) to judge the following sensory attributes; texture, visual appearance (colour), aroma and overall acceptability.

III. RESULTS AND DISCUSSION

Bread manufactures have on going interest in strains of baker's yeast, especially those that increase dough fermentation rates and yield a high quality final product (Ana et al., 2001. The result of the sensory evaluation in (Table 1) shows the mean scores for the parameters evaluated for colour, texture, aroma and overall acceptability. Bread samples were considered acceptable if their mean value for overall acceptability were equal or above 3.The higher value presents higher consumer acceptability.(Table 1)

Table 1: Analysis of variance of organoleptic attributes of sweetened and unsweetened bread samples made with wild yeast and its mutant species and commercial baker's yeast.

	Sample code					
Parameters	**A**	**B**	**C_1**	**C_2**	**D_2**	**D_2**
Texture	3.22^{b}	3.4^{b}	3.38^{ba}	2.88^{b}	3.22^{b}	3.4^{b}
Colour	4.44^{a}	4.9^{a}	4.38^{a}	4.13^{a}	4.44^{a}	4.9^{a}
Aroma	2.56^{b}	3.0^{b}	2.50^{b}	3.00^{b}	2.56^{b}	3.0^{b}
Overall acceptability	3.56^{a}	3.3^{b}	3.63^{a}	2.75^{b}	3.56^{a}	3.3^{b}

$P \leq 0.05$ DMRT

Key: A = Sweetened mutant bread, B= Unsweetened mutant bread, C_1 = Wild yeast sweetened bread, C_2 = Wild yeast unsweetened bread, D_1 = Control sweetened bread sample made with commercial baker's yeast, D_2 = Control unsweetened bread sample made with the commercial baker's yeast.

Means with different superscripts are significantly different by Duncans Multiple Range Test (DMRT) across row.

The results statistically showed that there was a significant difference between the mean values of the parameters ($p \leq 0.05$) in the wild, mutants and control samples of bread for both sweetened and unsweetened (Tables 1 and 2). DS20 mutant bread sample was the best with regards to the four parameters assessed with the mean values (4.25^a, 4.00^a), followed by 7F9 (4.00^a, 3.50^b) for both sweetened and unsweetened bread samples. Others include DS6 (3.75^a, 3.75^a), 7F8 (3.75^a, 3.75^a), and 2F36 ($3.50^{a,}$ 3.50^b) (Table 2).For the wild yeast bread samples all the samples tested were acceptable and the best was DS20 with a mean value (4.00^a) in sweetened sample, followed by DS6 (3.75^a) and the least was 2F36 (3.50^b) for both sweetened and unsweetened bread samples (Table 2).

For wild yeast bread samples all the samples tested were acceptable and the best was DS20 with a mean value (4.00^a) in sweetened sample, followed by DS6 (3.75^a) and the least was 2F36 (3.50^b) for both sweetened and unsweetened bread samples (Table 2). These samples tested compared favourable if not even better than the control samples which showed a mean value of (3.56^a, 3.3^b, 3.50^a, 4.50^a) for both sweetened and unsweetened bread samples in relation to the four parameters tested (Tables 1 and 2) i.e. for mutants of nitrous acid, wild parent and baker's yeast bread samples.The ultraviolet (UV) mutant bread samples were all preferred by the panelist based on the consumer acceptability assessment values at various intervals of mutation both for sweetened and unsweetened (Table 3).Considering the four parameters assessed in terms of the organoleptic properties, the following bread samples were ranked as the best in accordance to their mean value; for texture, colour, aroma and overall acceptability. The sweetened bread samples, texture, DS6 (3.57^a) at 15 minutes, colour DS10 (4.15^a) at 20 minutes. Aroma7F8 (4.43^a) at 6 minutes,overall acceptability, DS10 (4.15^a) at 20 minutes. This is followed by 7F9 (3.15^a) at 10 minutes, for texture, colour DS6 and DS20 (3.86^a) at 15 minutes and 20 minutes, aroma DS6 and DS10 (3.43^{bc}) at 10 minutes and 15 minutes and overall acceptability, DS6 and DS20 (3.86^a) at 15 minutes and 20 minutes.The following unsweetened bread samples showed the best results 7F9 (4.43^a) at 10 minutes for texture, colour, 7F9 (5.00^a) at 10 minutes, Aroma, 7F9 and DS6 (3.29^{ba}) at 15 minutes and 20 minutes and overall acceptability 7F9 (4.43^a) at 10 minutes. This is followed by 2F36 for texture, (4.00^{ba}) at 4 minutes, colour (4.86^a) for DS14, at 30 minutes, Aroma, 2F36 (3.00^{ba}) at 4 minutes (Table 3).

Table 2: Comparative analysis of the mean performance of the wild yeasts, its mutants and commercial baker's yeast on bread samples

$P \leq 0.05$ DMRT

Bread samples	**Sample code/Yeast strains**					
	Mutants		**Wild**		**Control (Baker's yeast)**	
	A	**B**	**C**	**D**	**E**	**F**
DS20	4.25^a	4.00^{ab}	4.00^a	2.50C	3.50^a	4.50^a
7F9	4.00^a	3.50^b	3.25^a	3.25^a	3.50^a	4.50^a
DS6	3.75^a	3.75^a	3.75^a	3.75^a	3.50^a	4.50^a
7F8	3.75^a	3.75^a	3.75^a	3.75^a	3.50^a	4.50^a
2F36	3.50^a	3.50^b	3.50^a	3.00^b	3.50^a	4.50^a

Key: A = Sweetened mutant bread, B = Unsweetened mutant bread, C= Wild yeast Sweetened bread, D = Wild yeast unsweetened bread, E= Control sweetened bread made with commercial baker's yeast, F = Control unsweetened bread made with commercial baker's yeast.

Mean values with different superscripts are significantly different by Duncan Multiple Range Test (DMRT) across the row ($P \leq 0.05$).

Table 3: Analysis of variance of organoleptic attributes of sweetened and unsweetened bread samples with mutant yeasts (ultra violet light).

Sample code	Parameters					Mutation time (minutes)			
	UVT (mins)	Texture mean score	Colour mean score	Aroma mean score	Overall acceptability mean score	UVT mean score texture	UVT mean score colour	UVT mean score aroma	UVT mean score overall acceptability
A									
2F36	4	2.86^{a}	3.51^{a}	3.71^{ba}	3.57^{a}	2.38^{a}	3.38^{a}	3.63^{a}	3.38^{a}
7F8	6	2.15^{a}	3.29^{a}	4.43^{a}	3.29^{a}	3.38^{a}	3.75^{a}	3.50^{a}	3.75^{a}
7F9	10	3.15^{a}	3.57^{a}	3.00^{a}	3.57^{a}	3.23^{a}	4.13^{a}	3.25^{a}	4.13^{a}
DS6	15	3.57^{a}	3.86^{a}	3.43^{a}	3.86^{a}	3.38^{a}	3.75^{a}	3.50^{a}	3.75^{a}
DS10	20	2.29^{a}	4.15^{a}	3.43^{a}	4.15^{a}	2.75^{a}	4.00^{a}	3.00^{a}	3.38^{a}
DS20	25	2.71^{a}	3.86^{a}	3.00^{a}	3.86^{a}	2.25^{a}	3.38^{a}	3.00^{a}	3.38^{a}
DS14	30	2.43^{a}	3.71^{a}	2.71^{c}	3.71^{a}	2.75^{a}	3.63^{a}	3.38^{a}	3.63^{a}
B									
2F36	4	4.00^{ba}	4.86^{a}	3.00^{ba}	3.71^{a}	3.29^{a}	4.51^{a}	3.29^{a}	3.57^{a}
7F8	6	2.88^{bc}	4.43^{a}	2.57^{ba}	3.71^{a}	3.13^{a}	4.43^{a}	3.15^{a}	4.43^{a}
7F9	10	4.43^{a}	5.00^{a}	3.29^{ba}	4.43^{a}	3.13^{a}	5.00^{a}	3.00^{a}	3.86^{a}
DS6	15	2.71^{c}	3.00^{b}	3.29^{ba}	4.15^{a}	3.29^{a}	4.15^{a}	3.00^{a}	4.14^{a}
DS10	20	3.43^{bac}	5.00^{a}	2.57^{ba}	4.00^{a}	4.00^{a}	4.86^{a}	2.57^{a}	3.71^{a}
DS20	25	3.57^{bac}	4.71^{a}	2.43^{b}	3.43^{a}	3.29^{a}	4.29^{a}	2.71^{a}	4.00^{a}
DS14	30	3.29^{bac}	4.86^{a}	3.43^{a}	4.29^{a}	4.15^{a}	4.57^{a}	3.43^{a}	3.86^{a}

Key: A= Sweetened mutant bread sample, B = Unsweetened mutant bread sample, UVT = Ultra Violet irradiated time in minutes, 2F36, 7F8, 7F9= Samples from fresh fermented orange juice, DS10, 14 and 20 = Samples from defective orange juice. Mean values with different superscripts are significantly different by Ducan Multiple Range Test (DMRT) across row ($p \leq 0.05$).

Considering the quality of the bread made from the yeast strains of wild, modified and baker's yeast in relation to consumer's overall acceptability, statistically in terms of texture, colour and aroma, the result showed the tested samples were well accepted by the panelist as a result of the higher value obtained. This result agrees with the report of (Cheng-chang et al, 2010), where they had a similar result that higher value presents higher consumer acceptability. Interestly, DS20, DS6, and 7F8 mutant bread samples ranked the best with regards to each of the parameters assessed when compared with the wild type and control samples in both sweetened and unsweetened bread (Table 2 and 3), these mutant bread samples had a better consumers' acceptance in relation to their organoleptic properties (texture, colour and aroma) than the wild type. This result in agreement with the findings of other workers (Ana *et al*., 2001; Wonghalaung and Boonyaratanakorkit, 2007 and Cheng-Chang *et al*., 2010). They showed that the product of bread baked with mutant baker's yeast had a better consumers' acceptance than its wild type.

IV. CONCLUSION

The abundance and availability of the wild yeast satisfy one of the basic requirements for the use of micro organisms in the fermentation industry. This study has shown that strain improvement technology such as genetic improvement technology can be achieved through mutations and the wild strains baking quality was greatly improved in both sweetened and unsweetened dough when compared with the bakers yeast. However, it was evident that the mutant strains have high potential for industrial application as a result of their better bread quality in terms of the parameters assessed for both sweetened and unsweetened.

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