Exploring Possibility of Using Davulkurundu (*Neolitsea involurate*) Leaf Extract to Improve Leavening Action and Crumb Structure of Wheat Bread

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ABSTRACT

A preliminary study revealed that *Davulkurudu* (*Neolitsea involurate*) leaf *(DKL)* extract is the best jelly source as against Ladies finger and *Dorian* seed extracts to manufacture high quality bread due to its heat instability nature. Five kg of wheat flour was incorporated with necessary ingredients and divided into two portions. One portion was mixed with water and the rest with *DKL* extract. Prepared doughs were allowed to ferment and the time taken to reach leavening index 2.0, an indicator to have a soft breadcrumb, were recorded. Leavening time, bulk density, pH value, organoleptic properties and stalling effect in terms of elasticity were evaluated. Results revealed that *DKL* extract incorporated bread dough had half an hour less leavening time and low bulk density (0.09) of bread than the normal bread (0.12) due to well develop bread crumb. However, *DKL* extract did not affect the pH value of bread. Organoleptic properties, texture, crumb cell distribution and over all acceptability of bread prepared with *DKL* were significantly better than the counter treatment except mouth feel, color and aroma. *DKL* extract was also capable of retarding stalling process by 6-8 h.

Key words: davulkurudu leaf extract, bread crumb, leavening index, bulk density, organoleptic properties

INTRODUCTION

Bread is a very popular food product across the society. Hence, the bakers can derive tangible and intangible benefits out of this product, if it is manufactured with right quality and in compliance with the regulatory requirement. The breads are to be manufactured in order to enhance perceptual sensitivity of the product by improving quality of bread crust and breadcrumb. Quality of breadcrumb is the most deciding factor as far as consumer preference is concerned as most of consumers, prefer to have a soft breadcrumb. Hence, the user, who inadvertently squeezes the loaf of bread in the market in order to make sure that the breadcrumb, is of right quality. Therefore, there is a vast potential exist to manufacture bread with a well developed soft breadcrumb in order to compete with the requirement in the dynamic market. Hence, scope of this study was to explore the possibility of incorporating plant extracts into the bread dough with the view to improve the crumb structure.

Preliminary studies carried out using three types of jell sources readily available in the natural habitat, namely *Davulkurudu* leaf (*DKL*) extract, which is heat unstable, Ladies finger and *Dorian* seed extracts, which are heat stable, reveled *DKL* extract as the best jell source for bread making. The heat stability nature of *Dorian* seed and ladies finger extract, badly affected quality of baked bread; especially on mouth feel and texture. The crumb of the bread made out of these two sources was also cited as watery and soggy that badly contribute for over all acceptability of the baked bread. On the other hand, the heat unstable nature of *DKL* extract resulted no aftermath effect on baked bread, and hence selected as the best jelly source for further studies on bread making.

The objectives of this study were to develop high quality crumb structure for bread using *Davulkurudu* leaf extract; to monitoring leavening index and leavening time of *Davulkurudu* leaf extract incorporated bread as against normal bread; and to evaluate organoleptic properties of bread prepared with *Davulkurudu* leaf extract as against normal bread.

MATERIALS AND METHODS

Preparation of bread dough with and without *Davulkurudu* leaf extract

Five kg of wheat flour, moisture content and gluten content of which were pre-determined (C.S.S. 144, 1972) were taken and subjected to the sieving process to remove grit and other foreign particles. The cleaned wheat flour was incorporated with 1.5% salt, 2.0% fat (shortening agent), 1.5% sugar, and 1.0%yeast (leavening agent) and mixed well using a spiral mixture. The mixture was divided into two equal portions and one portion was incorporated with calculated amount of water to get moisture content of the dough at 58%; the most desirable moisture content of the bread dough (Navaratne, 2004). Under mentioned formula was used to calculate the required amount of water for 100g of Wheat flour to get 58% moisture content in dough.

$$\frac{(58 - \text{Moisture content of Wheat flour})\ 100}{(100-58)}$$

The mixtures were subjected for mixing and kneading process for 15 minutes in line with bread manufacturing standard (Samuel, 1987). The dough were allowed for fermentation under normal atmospheric condition (RH 68-72%, ambient air temperature 28-32^{0}C). After completion of bulk fermentation process the bread dough were divided into small portions, weight of each was approximately 535g; and placed in baking pans for further fermentation. Thereafter the breads were baked in an oven, maintained at 260^0-270^0 C for 30 minutes (Samuel, 1987). Time taken to complete bulk and tray fermentations were recorded.

The rest portion of the wheat flour mixture was incorporated with *Davulkurudu* leaf extract, prepared by rubbing and crushing 10g of blanched leaves in 100ml of water. Since density of *DKL* extract is approximately equal to the density of water, the quantity of (Leaf extract) jell, to be incorporated into the dough to get moisture content 58% is considered equal to the quantity of water incorporated for previous dough.

The baked bread obtained from these two treatments were subjected to determining of leavening time, bulk density, pH value, moisture content (SLSI 141-1981) and organoleptic properties along with staling effect. The treatments were replicated thrice.

Leavening index of the bread dough

The desirable leavening index for bread manufacture is 2.0 (Swern, 1974). A portion of bread dough was taken and put into a measuring cylinder and was pressed a little to flatten the surface. Initial volume of the flatten dough was recorded and volume increment due to leavening action was recorded every half an hour until the volume of the dough increased by two fold.

$$\text{Leavening index} = \frac{\text{Increased volume (ml)}}{\text{Initial volume (ml)}}$$

pH value of baked bread

Approximately 20g of bread was dissolved in distilled water and kept for 15 minutes. Well-soaked bread portion was blended for 60 seconds and filtered through a Whatman No 01 filter paper. The filtration was used to determine pH value of the bread.

Moisture content of the bread

Approximately 5g of bread was taken from the middle of a bread loaf and placed in an Infra Red moisture balance, maintained at 95^0±2^{0}C. The bread portion was kept in the moisture meter until the reading was given by the meter automatically.

Bulk density of baked bread

A slice of bread, thickness approximately 4cm was taken from the middle of the loaf and weighed. The bread slice was shrink wrapped with shrink wrapping machine using a thin, weight-known polythene film. The wrapped bread slice was immersed in water at 15^{0}C and displacement volume of water was recorded. Under mentioned equation was used to calculate the bulk density of the bread.

$$\text{Bulk density of bread} = \frac{\text{Weight of the bread slice (g)}}{\text{Volume of the slice (cm}^3\text{)}}$$

Staling effect on bread in terms of elasticity

Since the elasticity of breadcrumb correlates to the staling process. This relationship was used to quantify the staling process of bread. A well-baked sample of three fresh breads, moisture content of which were maintained at 40% using 58% of *Davulkurudu* leaf extract in preparation of the bread dough, were taken and the hard bread crust was removed with a sharp knife. The crust less bread crumb was taken and cut into a rectangular shape (1.0*1.0* 4.0 cm^3) pieces (Bread fingers). The cut bread fingers, numbering about 80 were put into a pet-bottle and tight the lid for subsequent use. One bread finger was taken and one end of which was clipped about 1.0cm apart and placed over a ruler. The clipped was fixed to a stationary wooden surface. The other end of the bread piece was also clipped 1.0 cm apart from the end and left free. A strong thread was attached to the clip of free end and dragged gently over the slide ruler until breaking of the bread finger occurred. The maximum elongation length was recorded. The same procedure was adapted to measure elasticity of breadcrumbs 12, 24, 36, 48, 60, &72 h after manufacture. A graph was plotted with elongation length Vs age of the bread. Mean value of 10 bread fingers were taken as the elongation length. The same procedure was adopted to prepare three bread samples with pure water, using 58.0%of water in preparation of the dough (Navaratne, 2004) in order to compare degree of staling of both types of bread.

Organoleptic properties of the bread out of two treatments.

Organoleptic properties of bread manufactured with best treatment as against ordinary formula were evaluated by using 15-member sensory panel; while resorting Duo trio statistical techniques. Of which the respondents were asked to select best treatment out of two in terms of perceptual sensitivity towards different sensory stimuli; such as texture, mouth feel, color, smell appearance and over all acceptance of the bread. The statistical table ISO 5495; 1983E was used to interpret the data.

.RESULTS AND DISCUSSION

Leavening time of the bread

Two bread samples, numbering six loaves for each were prepared at a commercial bakery by using water and *Davulkurudu* leaf extract respectively. A portion of bread dough with respect to each treatment was subjected for leavening index test as against leavening time and the results (Mean value) are given in the table 1. The trial was replicated three times.

These results were used to plot graphs leavening index Vs leavening time, which is given in figure 1.

The graph in figure 1 clearly indicates that bread dough prepared out of *Davulkurudu* leaf extract takes two hours to reach the optimum-leavening index 2.0, a requirement for a soft breadcrumb, as against normal leavening time; which usually last about two and half hours. Therefore *DKL* extract has a significant influence on the leavening process of yeast as this extract is capable to reduce leavening time by half an hour. Reason for this low leavening time is the viscous nature of *DKL* extract; which facilitate to have a better shortening action along with the fat on the gluten net work of the dough. Usually the starch granules of wheat flour is encompassed with gluten, a water-soluble protein, absorb considerable of water molecules when preparation of the dough (Stear, 1990). Water absorbed gluten formed a gluten net work over the starch granules and shortening agent occupies in between these gluten net work. When shortening agent penetrates into the gluten net work, it will have a somewhat slippery action. When leavening agent act upon the starch granules of the dough it will release more and more CO2 gas. Due to accumulation of more and more CO_2 gas in the gluten net work, pressure points are being developed, that results in forming of a cell-structured body in the bread mass, called breadcrumb (Pomeranz, 1986). The shortening agent will facilitate for this process due to its slippery action. When bread dough is prepared with *DKL* extract instead of water, viscous nature of which would further facilitate to have a better slippery action than the bread dough prepared with water. The bread dough with better slippery action would accelerate the leavening process and because of that, it will take less

Table 1: Leavening index of dough samples prepared with &without *D.K.L* extract

Leavening time - hrs(Time taken to reach L.index 2.0)	Leavening index (Av. Value of 06 loaves)	
	Dough prepared with water	Dough prepared with *D.K,L* extract
00	00	00
0.5	0.4	0.6
1.0	1.2	1.5
1.5	1.4	1.75
2.0	1.8	2.0
2.5	2.0	
3.0		

time to reach the leavening index 2.0. Hence, viscous nature of *DKL* extract has a good effect in accelerating of the leavening process.

Bulk density and pH values of baked bread

Bulk density and pH values of bread prepared with water and *DKL* extract are given in table 2. In calculation of these values, 9 loaves of breads were taken into consideration.

The values given in table 2 clearly indicate that *DKL* extract incorporated bread having a less bulk density than the bread prepared with water. Reason for this phenomenon is forming of a well-developed breadcrumb in the *DKL* extract incorporated bread. When breadcrumb is formed with more and uniform crumb cells, volume of the bread is also concurrently being increased; (Jackel, 1981) that results in having a less bulk density bread. This conclusion is further evidenced by the values of mean variation of the two treatments as *DKL* extract incorporated bread having a low bulk density with a less mean variation. In the case of pH values of both treatments, there is no significant difference as against regulatory requirement of 5.2-6.0. Reason for this phenomenon is that there is no over fermentation process occurring in these two treatments as both treatments fulfill the requirement of the leavening process of the leavening agent.

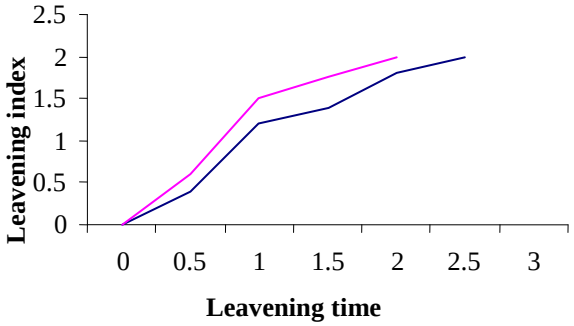

Figure 1: Relation ship between leavening time and leavening index

Organoleptic properties of bread manufactured with and without *Davulkurudu* leaf (*DKL*) extract

Organoleptic properties of *DKL* extract incorporated bread were compared as against same properties of ordinary bread for following sensory stimuli

Texture of bread

An important sensory characteristic in manufacturing of high quality bread. A better perceptual sensitivity of which leads to have a better demand for the product. The results obtained for this character by sensory evaluation is given in the table 3.

The response behavior for texture, cited in table 3 clearly indicates that there is a significant difference between bread manufactured with and without *DKL* extract as bread manufactured with *DKL* extract secured 13 responses in favor for texture as against same bread prepared with water. Reason for higher sensory rating for texture is well developed uniform and smooth cell structure of the breadcrumb (Pomper and Davis, 1989). This is more elastic and sponge in nature. Hence respondents in the sensory panel were emotionally compelled to rate the breadcrumb of *DKL* extract with a higher degree of perception. Reason for development of a super breadcrumb in

Table 2: Bulk density and pH value of bread prepared with two treatments

Mean bulk density of 9 loaves gcm^{-3}		Mean pH value of 9 loaves	
With D.K.L extract	**With water**	**With D.K.L extract**	**With water**
0.09	0.12	5.8-6.0	5.4-6.0
ẍ± SD 0.086±0.007	ẍ± SD 0.129 ±0.017	ẍ± SD 5.83±0.067	ẍ± SD 5.43 ±0.149

Regulatory requirement for pH 5.2-6.0

DKL extract incorporated bread is the activity of yeast, which released substantial amount of tiny CO_2 bubbles into the dough during fermentation. Released CO_2 bubbles already encompassed by the glutton net work, tend to stretch in order to with hold these bubbles due to its elastic nature (Jackel, 1981).

If the bread dough contained shortening agent and jelly materials, that will further facilitate to have a smooth function of the expansion process. This will result, in forming of a smooth breadcrumb in the bread mass. Hence, incorporation of *DKL* extract into the bread dough can achieve a remarkable improvement in quality of bread particularly in improving of elasticity, softness and sponginess of the breadcrumb.

Mouth feel of the bread

Mouths feel is also a very important sensory characteristic as far as quality of bread is concerned. This character was also evaluated by sensory mean with the same 15 member sensory panel and results are given in table 3.

The results in the table 3 clearly indicate that there is no significant difference in mouth feel between bread manufactured with water and *DKL* extract. As in accordance with the table, ISO 5495-1983E two sided test for duo trio trial indicate that minimum response to be secured in favor for a significant difference is 12. However, under this circumstance, which is 08 & 07. Hence, incorporation of *DK*L extract does not have an adverse effect on the sensory stimulus of mouth feel. Reason for no contrast in mouth feel is breaking down of jells of *Davulkurudu* leaf into water and other minor constituents during the process of baking.

Color of the breadcrumb

Color of the breadcrumb is also a deciding factor for inducement of the palatability of the product. This sensory stimulus was also evaluated by using same sensory panel and results are given in the table 3.

The perceptual sensitivity of respondents for color is given in the table 3 clearly indicates that there is no significant difference between bread prepared out of water and *DKL* extract as two treatments failed to secure required number of responses. According to the table ISO 5495 1983E, a sensory stimulus should be secured at least 12 responses in favor for a significant difference (If 15 member sensory panel is made use). Reason for this phenomenon is the color of the *DKL* extract, incorporated wheat flour found to be similar to the color of water soaked wheat flour (Ranken,1988).

Aroma of the bread

The response behavior of respondents for smell is given in table 3 clearly indicates that there is no significant difference between bread prepared out of *DKL* extract and water as these two treatments again failed to secure minimum responses of 12 as against each other. Reason for this insignificant feature is highly volatile

Table 3: Organoleptic properties of bread manufactured with and without *D.K.L* extract

Sensory stimulus	Number of responses received in favor	
	Bread prepared with *D.K.L* extract (5 repetitions)	**Bread prepared with water (5 repetitions)**
Texture	15, 12, 13, 15, 13	00, 03, 02, 00, 02
Mean	13.6	1.4
Mouth feel	07, 09, 08, 08, 10	08, 07, 06, 07, 05
Mean	08	07
Color	08, 09, 07, 10, 09	07, 06, 08, 05, 06
Mean	09	06
Smell	08, 09, 07, 10, 06	07, 06, 08, 05, 09
Mean	08	07
Crumb structure	12, 15, 13, 14, 12	03, 03, 02, 01, 03
Mean	13	02
Over all acceptability	14, 13, 12, 09, 15	01, 02, 03, 06, 00
Mean	13	02

nature of the constituents, responsible for offensive smell of *DKL* extract rapidly being evaporated during baking process.

Crumb cells distribution

Distribution pattern of crumb cells in the bread mass is a very impotent factor as which clearly depict, whether the right quality raw materials and right techniques are being adopted along with skill of the baker. In order to asses this factor slices of bread were taken from both treatments and asked 15 member sensory panel to indicate their choice (Table 3).

The response behavior of respondents for crumb structure given in the table 03 clearly indicates that D.K.L extract incorporated breads were able to secure more than 12 responses in favor as against its rival treatment. Therefore, incorporation of *D.K.L* extract in preparation of bread dough will facilitate to leavening process remarkably. Because this extract has a capacity to boost the leavening process due to its jelly and slippery nature, which would impart an additional shortening effect on the leavening process of the bread dough. The principle of the leavening process and role of *D.K.L* extract are as same as the role described in the texture of bread (Jackel, 1981).

Overall acceptability of the product

Over all acceptability of the two bread types were also evaluated by sensory mean (table 3).

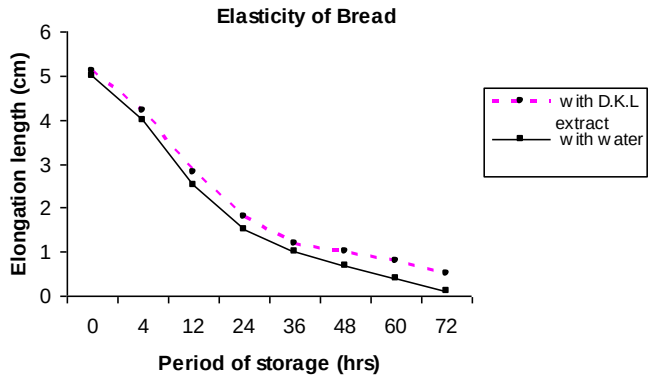

Figure 2: Relationship between elasticity of bread and period of storage

The over all acceptability of two different treatments clearly indicates that *DKL* extract incorporated bread were able to secure more than 12 responses in favor as against its rival treatment. Therefore, bread prepared out of *DKL* extracts has a better acceptability than the bread prepared with water. Reason for this phenomenon is better texture; uniform crumb cells distribution and somewhat better mouth feel due to softness of the breadcrumb of *DKL* extract incorporated bread.

Staling effect on bread manufactured with and without *DKL* extract

Transforming of baked bread into an unpalatable state is called staling, which badly affects the quality of bakery products during storage. Since the stalling process is corresponding to the elasticity of the breadcrumb, a study was carried out to measure this property as against time factor, using 10 numbers of bread fingers from each treatment.

The graph in figure 2 clearly illustrates that *DKL* extract incorporated bread can be kept 6-8 more hours than the bread prepared with water. Reason for the staling effect of bread is behavior of the starch granules; which have been formed with two constituents - amylose and amylopectin (Swaminathan, 1988). While amylopectin is multi branch glucose molecules, amylose is in singular form of glucose molecules. During baking process of bread multi branch of amylopectin spread outward while amylose retained as it is. The spread out multi branches of amylopectin begin to shrink backward gradually during stalling process is going on as a result of various reasons, such as ambient oxygen, water vapor, emulsifiers etc (Slade and Levine, 1991). However, no movement is occurred in amylose. When bread is prepared with *DKL* extract, the leaf extract makes a microfilm over the starch granules even the property of jell being destroyed at baking process. The film act as a barrier to some extent for factors, responsible for stalling. Hence *Davulkurudu* leaf extract incorporated bread can be kept relatively some what more time than the bread prepared with water. Therefore, *Davulkurudu* leaf extract is capable to control staling process of bread into some extent.

CONCLUSION

Softness of the breadcrumb improved significantlywhen *DKL* extract added to bread. Data base of Hrischandra Mills Ltd revealed that about 6% of bakery products being lost due to stalling effect. This is a huge quality cost for the company. This study revealed that DKL extract could extend the shelf life of bread by about 8 h as against usual shelf life of 32 h. Hence, about 25% of losses due to stalling process can be prevented by incorporation *DKL* extract. This study was also revealed that about 15% of yeast requirement of the dough can be reduced, if wheat flour is incorporated with well prepared *DKL* extract.

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