

The Potential of Five Indigenous Plants of Ifugao as Functional Loaf Bread Ingredients (Preservative & Flavouring)

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Abstract: The five kinds of selected indigenous plants, Pandan, (Pandanus amaryllifolios) Lemon Grass (Cymbopogon sp.) Apin, Terstroumonia gitengensis Elm), Ginger (Zingier officinale) and Garlic (Allium sativum) was used as food preservatives and flavouring agent in the preparation of loaf bread. Temperature is one factor that affects retrogression of the finished product. Under physical appearance the growth of moulds that affects palatability and acceptability of bread. Result showed that among the treatments/flavour experimented lemon grass (Cymbopogon sp.) which contains citral has the longest shelf-life with five days at room temperature, the rest of the treatments last only for 3 days. With the levels of acceptability control marks the highest followed by lemon grass, pandan and apin leaves, garlic and ginger. Likewise, the acceptability of bread is directly correlated to its shape, texture, shelf-life and its aroma.

Pandan (Pandanus amaryllifolios) bread has the highest return of investment with 10.39% followed by Lemon grass (Cymbopogon sp.) bread with 8.20%, Apin (Terstroumonia gitengensis Elm) bread with 7.68%, Garlic (Ginger officinale) bread and ginger (Allium sativum) bread with 6.65% and the control (without flavor) which is only 4.58%. In general the efficacy of the five indigenous plants use as preservative and flavouring agents contains different vitamins, and minerals, anti-bacterial properties and anti-oxidants that strongly help to suppress the maturation of mold on bread and increase the shelf life of bread, thus, it helps to preserve the bread.

Keywords: Indigenous Plants, Natural Food, Preservatives and Flavouring, Beneficial to Health.

I. INTRODUCTION

Indigenous plants are excellent sources of organic food that contributes to good health and human wellness. Today most food entrepreneurs used artificial preservatives to prevent spoilage. However, scientist and technologies continuously discovers and developed indigenous food products to minimize the use of chemical preservatives which shortens life and harmful/hazardous to health.

(Louisa Dalton 2007) Preservatives work by killing or stopping the growth of microorganism. Moulds that grow on decaying food are dangerous. The most notorious case in food history is the fungus ergot (Claviceps pupurea) which used to grow on rye bread causing mass epidemics hallucinogenic delusions. Modern preservatives such as potassium sorbate and sodium benzoate are specific inhibitors of bacteria. Benzoic acid is widely used in fruit preservation. Ascorbic acid is the most widely used preservatives, its unsaturated acid found in some plants. Nisin is a natural antibiotic substance occurring in milk and cheddar and Cheshire cheeses.

Food Drug and Authority (FDA) states that sulphur dioxides are found in dried fruits like packed tomatoes, potatoes, red wine, lemon juices and Hawaiian coconut syrup. Sulfites are also used in wine preparation and to lengthen the life of fruit juices. Chlorogenic acid and caffeic acid found in pandan leaves. (pandanus amaryllifolios) are anti-oxidants in vitro and contribute to the prevention of diabetes mellitus and cardiovascular disease. Pandan leaves were evaluated for repellent activity against blatella germanica. Pandanus extract has a delightful scent and gives the rice and bake products a lovely

fragrance. Modern bakeries used the wide ranging greens of cake sold in bakeries without the use of food coloring or bottled pandan paste.

Write (2006) says that important part of Southeast Asian Cuisine, especially in Thai food and has been used in flavouring for culinary uses, Lemon Grass features in Indonesian, Malaysian, Sri Lankan and Indian cooking and is widely used in savory dishes and meat, poultry, seafood and vegetable curries. It harmonizes well with coconut milk, especially with chicken and seafood and there are countless Thai and Sri Lankan recipes exploiting this combination. The stems are also used in pickles and flavouring marinades. Lemon grass is also used as food flavouring and fragrance in beauty products. The plant possesses bacterial and anti-fungal effects as well as anti-carcinogenic actions.

“Apin leaves” (*Terstoumia gitengensis* Elm.) was used in the preparation of loaf bread. Based on the food analysis of the Department of Science and Technology (DOST) for every 300 grams fresh leaves of “Apin” contains the following food nutrients: Ash 3.00%, Carbohydrates 17.36%, Crude Fat 0.51% were used to flavour in cooked rice and also “Kakanin or Malagkit” (Glutinous Rice Products) because of the vibrantly colouring green similar to pandan. This plant is a kind of shrub that grow anywhere and along creeks. It has elongated shape of thick green leaf.

Ginger (*Zingier officinale*) is one of the most important and valued spices. A tropical herbaceous perennial with underground rhizomes from which stalks arise up to 3 feet tall. Ginger contains gingerol and shagaol (oleoresins), also found in the plants, potassium, magnesium, phosphorus, vitamin B6, vitamin C and Calcium.

Garlic appears to have anti-bacterial anti-viral properties (Salmond, Christine.,et.al). Garlic contains cinnamic, propionic, benzoic and ascorbic acids. The effect of these chemicals on the growth and intracellular pH *Esherichia coli* investigated. This study suggests that the potency of weak acids as food preservatives is related to their capacity to reduce specifically the intracellular pH. The main phytochemicals in garlic are Allin, Methin and S-allylcysteine. When garlic is damaged or crushed the sulphur components are transformed in different organosulphur compounds.

The longevity of bread is a factor for its profitability so as much as possible food like bread should be consumed before spoilage. Spoilage may be influence by flavour, temperature, Chemical properties technological properties and microbial properties (Henryk 2012 and Kihlberg 2004).

Another important factor for the market value of bread is its acceptability to consumers. It determines the satisfaction of the consumers’ wants or even their needs. Acceptability maybe determine and influence by the different physical and chemical properties of the processed food like bread such as aroma, shape, size, texture, color and flavour (Dilbaghi, N. and Sharma S. 2007 and Clark J. 1998).

In this study, extracts of the five indigenous plants like pandan (*pandanus amarylifolious*), Lemon grass (*Cymbopogon* sp.), Apin (*Terstroumonia gitengensis* Elm), Ginger (*Zinger officinale*), and Garlic (*Allium sativum*) mixed with other ingredients like sugar, salt, honey, lecithin in eggs, cheese and cinnamon were use as preservatives and flavouring to increase the shelf-life of loaf bread that is beneficial to health of the consumers. (Aliguyon, Patricia A. 2012).

In the province of Ifugao, the most common ingredients and flavouring used by housewives, and food processors were salt, sugar, honey, cinnamon, garlic, ginger, vinegar, calamansi juice, or ascorbic acid, citrus juices, lecithin in eggs, and native yeast “binokbok” that are used both in bread, meat, fish, fruits and vegetables and wine preparation. These ingredients mentioned as preservatives and flavouring was primarily used in this study to increase the shelf-life of the products.

Finally, this study focuses on discovering the potential of indigenous plants preservatives and flavouring as functional loaf bread ingredients use to improve and prolongs the shelf-life of baked breads that are beneficial to health of the consumes.

II. OBJECTIVES

1. To determine the effect of the potential plants on the shelf-life of the loaf bread.
2. To determine the level on the use of the different potential plants in the improvement of loaf bread shelf-life.
3. Evaluate the acceptability and profitability of each product treated with the selected indigenous plants preservatives.

III. RESEARCH METHODOLOGY

This study was experimental. There were five indigenous plants selected in the study. Each of the herbal plant was weighed/measured and extracted using the standard recipe for bread. The ratio of ingredients and proportions were used as follows: 2000 grams' bread flour, 240 grams' white sugar, 35 grams shortening, 30 grams' yeast, 1000 grams' water. All ingredients were mixed and baked at 350 to 375F. After which the processed of bread preparation was done and stored in shelves at room temperature for evaluation and observation. These were done for five times in five replications until the final product was perfect. Finished products were also evaluated to determine the acceptability of marketability and profitability of consumers.

1. Indigenous plants- There were five indigenous plants used as preservative and flavouring ingredient in the preparation of bake loaf breads. T 0- control (no flavouring) T1- pandan extract, T2- Apin Extract, T3- Lemon Grass extract, T4 Garlic Extract, Treatment 5- Ginger Extract.
2. Formulation Testing- Each treatment was tested with different measurements. There were three formulation contains 200 grams 250 grams and 300 grams of fresh leaves, chopped and boiled for fifteen to twenty (15-20) minutes with two cups of water. Concoction of each indigenous plant was extracted using an osterizer, strained, and measured accurately for each mixture/recipe.
3. Acceptable Formulations- Based on the three formulations 300 grams of fresh leaves was selected to be the most effective and safest to use. According to DOST 300 grams is the most acceptable volume in analysing the nutrients of food to be more effective. Tested recipes were done and were finalized with the accurate formula using the hedonic scale for each treatment.
4. Shelf-life Evaluation- Bread was evaluated through the physical appearance, temperature and the chemical reaction at room temperature (37 C). Each treatment were evaluated, observed and recorded for a specific number of days to determine which of the five treatments has the shortest, longest shelf –life and most liking bread.
5. Market Testing-Finished product were sold and evaluated to determine costumers' preferences which of the five indigenous preservatives is more palatable and acceptable as functional flavouring agent at a given period of time (two weeks).
6. Profitability Analysis- Profitability was analysed and was determined based on the ROI formula.

Process in the Preparation of Loaf Breads

1. Weighing- is the process of measuring the ingredients by the use of weighing scale.
2. Mixing- is the process of combining all ingredients together to form dough.
3. Kneading- refers to the pressing, folding and stretching of the mixture to develop gluten for good bread structure. In Filipino language, this is known as MASA” for “MASAHE”
4. Punching- is the process of setting aside the dough for an hour to increase its volume before its final make-up.
5. Resting- is the process of setting aside the dough for an hour to increase its volume before its final make up.
6. Make-up/Shaping- is the process of scaling, rounding, moulding and proofing the dough after resting/fermentation.
7. Proofing- The time needed to make the dough rise. This start with the placing of the dough in the proofing.
8. Baking- is the method of cooking in dry heat/drying or hardening by heat.
9. Cooling- removing the product from the oven and let it stand for a few minutes to decrease its temperature.
10. Packaging- Packed the baked bread with the commercialized loaf bread plastic bags and was labelled according to the name of plant flavourings.
11. Storing- Stocking the bread in a convenient cabinet for further evaluation and further observations.

Research Environment

The research study was conducted at the College of Home Science and Industry IFSU, Potia Campus. The workplace was conducive due to the availability of the bakery room and baking room, tools and equipment used during the experimental process and conduct of the study.

Data Collection Procedure

Data were gathered from the panel of evaluators who actually checked, tasted and evaluated the breads using score cards for bread characteristics and general acceptability. Observation and evaluation was done on the six treatments for three to five consecutive days. Evaluators consist of 10 male and 10 female employees of the Ifugao State University. They were invited based on their known experience and knowledge in baking and eating breads as regards to the desirable quality of breads.

Research Methodology

Based on chemical analysis of the five indigenous plants explains the phytochemicals and nutrients of the indigenous plants used are the following:

- Pandan (*Pandanus amaryllifolius*), these leaves are fully loaded with essential oils, traces of tannin, alkaloids and glycosides. It has also diuretic properties and found to be very beneficial for various health conditions.
- Lemon grass (*Cymbopogon* sp.) has many health benefits and healing properties containing many compounds oils, minerals and vitamins that are known to have anti-oxidant and disease preventing properties.
- “Apin leaves” (*Terstroumia Gitengensis* Elm.) was used in the preparation of loaf bread. Based on the food analysis of the Department of Science and Technology (DOST-Philippines) “For every 300 grams fresh leaves “Apin” contains the following food nutrients: Ash 3%, carbohydrates 17.36%, Crude Fat 0.51%, Crude Protein 8.89% Moisture 70.24% and Energy kcal 110%. According to old folks the leaves were used to flavour in cooked rice and also “Kakanin or Malagkit” because of the vibrantly coloring green similar to pandan. This is a kind of shrub that grow anywhere and along creeks. It has elongated shape of thick green leaf. (DOST 2011).
- Ginger (*Zingier officinale*) is one of the most important spices. Ginger has been use for its anti-inflammatory, carminative, anti-flatulent and anti-microbial properties. Ginger root is a culinary used in the Surinam cuisine for spicing food and drinks. Ginger contains gingerol, zingerone, shagaol, farnesene, small amounts of B-phelladene, cineol and citral.
- Garlic appears to have anti-bacterial anti-viral properties. Garlic contains cinnamic, propionic, benzoic and ascorbic acids. The effect of these chemicals on the growth and intracellular pH *Escherichia coli* investigated.

The shelf-life of bread in the different treatment/flavours is shown in table 1 that all of the treatment is edible in the shelf for three (3) days except Lemon grass which took until five (5) days. All products experimented was stocked and observed at room temperature with 37 °C.

Table 1. Shelf-life of bread for the different treatment

Treatment (Flavour)	Average shelf-life of Bread (Days)
Control	3
Pandan Extract	3
Lemon Grass Extract	5
Apin Extract	3
Ginger Extract	3
Garlic Extract	3
TOTAL	3.3

Table 1 shows the result of the five treatments, and shows that Lemon grass (*Cymbopogon*) has the longest period of shelf-life. The primary chemical component in lemongrass is critical which has a strong anti-microbial and anti-fungal property. Lemon grass therefore inhibits microbial and bacterial growth in the body both internally and externally. (Dr. Rivka Offir and Prof. Yakov Weinstein from the department of Microbiology and Immunology). In general, the five indigenous plants use as preservative and flavouring agent contains different vitamins and minerals have their specific functions to enhance the palatability, acceptability, shape, color, texture, and aroma. Anti-bacterial properties and anti-

oxidants are contributory factors that helps to suppress the maturation of moulds on bread, increase the shelf life of bread, thus, it helps to preserve the bread.

Table 2. Levels of Acceptability of the Different Treatment (Flavours)

Treatment (Flavour)	Average Level of Acceptability
Control	5.0
Pandan Leaves	3.6
Apin Leaves	3.6
Lemon Grass	4.5
Garlic	2.2
Ginger	2.0

Note: 5=Like very much; 4=like moderately; 3=like; 2=dislike; 1=dislike very much

Table 2 shows that the most acceptable flavour bread in the study is the control (without preservatives) with level of acceptability of 5 followed by lemon grass (*Cymbopogon* sp.) with 4.5 Pandan (*Pandanus amarylifolius*) leaves and Apin (*Terstroumonia gitengesis* Elm) leaves with both 3.6 garlic (*Allium Sativum*) with 2.2 and with only 2 which is the least acceptable among the flavors

Table 3. Analysis of Variance (ANOVA) of the average acceptability of the different Flavorings

Source of Variation	SS	df	MS	F	P-value	5%	1%	F crit	F crit	Remarks
Treatment	18.94	5	3.79	31	8.9E-06	3.33	5.64	ns		
Replication	2.111	2	1.06	8.64	0.00663	4.1	7.56			
Error	1.222	10	0.12							
Total	22.28	17								

Note: ns=not significant

As shown in table 3 there is no significant difference (ANOVA) on the average level of acceptability between the different indigenous plant functional flavourings in the study.

Table 4. Correlations for Acceptability of Bread and Treatment (Flavour)

	Acceptability	Treatment (Flavour)
Acceptability Person	1	-736(**)
Correlation		
Sig. (2-Tailed)		
N	60	60

**** Correlation is significant at the 0.01 level (2-tailed)**

Table 4 shows that acceptability of the bread process with the different indigenous plant preservatives flavours is negatively correlated to the shelf-life.

Table 5. Correlations for Acceptability of Bread and its shelf-life

	Acceptability	Shelf-life
Acceptability Pearson Correlation	1	.259(*)
Sig. (2 tailed)		.046
N	60	60

**** Correlation is significant at the 0.01 level (2 tailed)**

Table 6. Correlation for acceptability Bread and Texture

		Acceptability	Texture
Acceptability	Pearson Correlation	1	.383(*)
	Sig. (2 tailed)		.046
	N	60	60

*Correlation is significant at the 0.05 level (2-tailed)

Table 6 showing that there is positive correlation of acceptability and the texture of the processed bread in different flavor. Likewise, acceptability of the bread is also highly significant with the aroma (shown in Table 7).

Table 7. Correlations for Acceptability of Bread and the Aroma

		Acceptability	Aroma
Acceptability	Pearson Correlation	1	-.876 (**)
	Sig. (2-tailed)		.000
	N	60	60

** Correlation is significant at the 0.01 level (2-tailed)

Table 8. Correlations Matrix of the Different Parameters

		Treatment/ flavor	Acceptability	Shape	color	Texture	Shelf-life	Aroma
Treatment	Pearson Correlation	1						
	Sig. (2-tailed)							
Acceptability	Pearson Correlation	-.736(**)	1					
	Sig. (2-tailed)	.000						
Shape	Pearson Correlation	-.245	.671(**)	1				
	Sig. (2-tailed)	.059	.000					
Color	Pearson Correlation	.122	.173	.559(**)	1			
	Sig. (2-tailed)	.352	.187	.000				
Texture	Pearson Correlation	.064	.259(*)	.619(**)	.663(**)	1		
	Sig. (2-tailed)	.625	.046	.000	.000			
Shelf-life	Pearson Correlation	.131	.383(**)	.467(**)	.145	.456(**)	1	
	Sig. (2-tailed)	.319	.003	.000	.268	.000		
Aroma	Pearson Correlation	.883(**)	-.876(**)	-.423(**)	.112	-.036	-.270(*)	1
	Sig. (2-tailed)	.000	.000	.001	.394	.784	.037	

** Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed)

Table 9. Comparison of Profitability of the Different Treatment/Flavours

Treatment/ Flavor	Expenditures (₱)	Total Sales (₱)	Profit (₱)	Return of Investment (ROI) %
Control	6, 567.46	6, 868	300.54	4.58
Pandan Leaves	6, 567.46	7, 250	682. 54	10.39
Apin Leaves	6, 567.46	7, 072	504.54	7.68
Lemon Grass	6, 567.46	7, 106	538.54	8.20
Garlic	6, 687.46	7, 004	436.54	6.65
Ginger	6, 627.46	7,004	436. 54	6.65
Total	39, 584.76	28, 050	2899.24	44.15

Table 9 shows the profitability of the different treatment/flavours being experimented. It shows that the pandan (*Pandanus amarylifolius*) leaves has the highest return of investment with 10.39% followed by lemon grass (*Cymbopogon* sp.) with 8.20%, Apin leaves (*Terstroumonia gitengensis* Elm) with 7.68% Garlic and Ginger with 6.65% and the control (without flavor) which is only 4.58%

The profitability of bread is affected by the consumer's choice and it is directly related to its physical and chemical properties such as aroma, color, shape, and texture (Dilbaghi, N. and Sharma S. 2007 Clark J. 1998).

The five indigenous plants were experimented through the concoction of the plants of each kind using an accurate measurement of a standard recipe for the bread. Five treatment formulations were prepared: Treatment 0- Control; Treatment 1-Pandan Extract; Treatment 2- Lemon Grass Extract; Treatment 3- Apin Extract; Treatment 4-Ginger Extract and Treatment 5-Garlic Extract which was experimented for five times to come up with a final product.

Result showed that among the treatment/flavour experimented lemon grass has longest shelf-life with 5 days the rest of the treatments last only for 3 days. With the levels of acceptability control marks the highest followed by Lemon Grass, Pandan and Apin leaves, garlic and ginger. Likewise, the acceptability of bread is directly correlated to its shape, texture, shelf-life and its aroma. Pandan bread with 8.20%, Apin bread with 7.68%, Garlic bread and ginger bread with 6.65% and the control (without flavour) which is only 4.58%.

IV. CONCLUSION

In general, this study found out that shelf-life of bread is influence by its physical, chemical, and microbial properties of bread. Among the treatments experimented Lemon grass as an indigenous functional flavouring of bread last up to 5 days in the shelves compared to other which last only up to 3 days. Likewise, pandan leaves contains a delightful scent and has the highest return of investment with 10.39% followed by lemon grass with 8.20% because of the aromatic flavour, Apin leaves with 7.68%, Garlic with 6.65% and the control (without flavour) which is only 4.58%. The acceptability of bread is directly correlated to its shape, texture, shelf-life and its aroma.

V. RECOMMENDATIONS

Based on the findings and conclusion of this study, the following recommendations are made:

1. Production of bread made up of pandan, (*Pandanus amarylifolius*) lemon grass (*Cymbopogon*) and Apin (*Testroumonia Gitengensis* Elm) leaves for they are tested to be profitable and acceptable to market. Verbal feedbacks from the consumers emphasize that aroma or flavoured breads that can encourage consumers to buy.
2. The indigenous raw materials such as the pandan, lemon grass, ginger and garlic should be subjected to chemical analysis to know the chemical substances that helps suppresses the growth of molds and bacteria as well as their nutritive value.
3. If possible a follow up study should be conducted to strengthen the evidence of the shelf-life, acceptability, marketability and profitability of the indigenous raw materials use in this study.

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