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Production of Dried OGI Spiced with Cloves Using Response Surface Methodology

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Abstract: *Production of dried ogi spiced with cloves using response surface methodology was studied. A central composite rotatable experimental design with two factors and five levels was used. The independent factors were maize X_1 (1.00 – 3.00kg) and clove X_2 (0.40 – 1.00g). The responses were moisture (Y_1), protein (Y_2), fat (Y_3), crude fiber (Y_4), ash (Y_5), carbohydrate (Y_6), and overall acceptability (Y_7). Thirteen (13) trials including five replicates were used. The moisture, protein, fat, fiber, ash, carbohydrate and overall acceptability ranged from 6.0-11.30%, 5.40-10.60%, 0.5-1.35%, 3.01-5.23%, 0.52-1.13%, 72-79.15% and 6.2-7.40% respectively. As the quantity of ogi increases, there was increase in the moisture, protein and carbohydrate contents and decrease as cloves increases. The Fat and overall acceptability increases as the quantity of cloves increases. The sensory evaluation revealed that the ogi porridge spiced with cloves from 3.00kg maize and 0.40g clove was most preferred by the panelists.*

Keywords*: Dried ogi, cloves, response surface methodology*

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I. Introduction

Maize is grown widely throughout the world in various agro-ecological environments. In Africa, Nigeria is the largest producer with nearly 8 millions tons, followed by South Africa producing 28% (1). According to IITA (2) report, maize contains 80% carbohydrate, 10% protein, 3.5% fibre and 2% mineral. 'Ogi' is a fermented non-alcoholic starchy food and is a major staple food widely consumed in West Africa. It serves as a weaning food for infants (3). It is described as food for the poor because it is cheap and widely available (4), it also serve as a main meal for adult, sick patients and convalescing patients because it can easily be digested. The traditional preparation of Ogi involves soaking of grains free of dirt and impurities in cold water inside earthen pot or plastic for 1 – 3 days. Then the grains are washed with clean water severally and later milled to paste. The residue which remains after sieving was later discarded as animal food while the filtrate was fermented (for 2-3 days) to yield Ogi which is sour white starchy sediment (5).

'Spice' is a dried seed, fruit, root bark or vegetable substance primarily used for flavouring, colouring or preserving food (6). There are different types of spices which are: black pepper, celery seeds, caraway seeds, ginger, garlic, black cumin, clove, coriander, sesame, cinnamon, nutmeg, onion, savory, chilli pepper, cassia, tobacco, pepper, star anise etc.

'Cloves' are aromatic flower buds of a tree in the family *myrtaceae*, genus *syzygium* and species *Syzygium aromaticum*. They have a sweet, some-what penetrating flavor and can be bought whole or ground (7). Cloves may be used internally as tea and as an oil for hypotonic muscles and for multiple sclerosis.

Response surface methodology (RSM) is a collection of mathematical and statistical techniques for empirical model building. The objective is to optimize a response surface (output variable) which is influenced by several independent variables (input variables). Originally, RSM was developed to model experimental responses (8).

There was no information on the production of dried ogi with clove using response surface methodology (RSM). Therefore, the aim of this research was to determine the quality of dried ogi spiced with cloves using response surface methodology.

II. Materials and Method

2.1 Materials

The materials (yellow maize and cloves) were purchased at mile 12 market in Lagos State, Nigeria. The materials were cleaned to remove the broken and cracked grains, stones and foreign materials.

2.2 Production of dried ogi spiced with clove

The method described by Odunfa and Adeyele (9) was used in the production of Ogi. The maize was washed with clean water, steeped in clean water for 2 days. After 2 days, the water was decanted and the cloves were cleaned, washed with clean water and were incorporated to the maize before milling in batches. Maize were milled into slurry. Then the slurry was sieved using muslin cloth in order to separate the pomace from the filterate and the filterate was allowed to ferment and sediment, later dried in a cabinet drier at 60^oC for 2 hours, sieved and then packaged in polyethylene films prior to analysis.

2.3 Experimental design

RSM technique was used to optimize the maize and cloves. The data obtained were analyzed by multivariate statistical analysis. A second order central composite response surface design was used in designing the experiment using five generated levels. 13 combinations including five replicates were performed in random. Seven (7) independent variables namely moisture content (Y_1), protein content (Y_2), fat content (Y_3), crude fibre (Y_4), ash content (Y_5), carbohydrate (Y_6), and overall acceptability (Y_7) were considered to evaluate the effects of the independent variables. The coded values of the 2 independent variable are shown in Table 1.

TABLE 1: Coded Level for Independent Variables

	– α	**– 1**	**0**	**+ 1**	**+ α**
Maize (kg)	0.59	1.00	2.00	3.00	3.41
Cloves (g)	0.28	0.4	0.7	1.0	1.12

2.4 Analysis

Moisture, protein, fat, crude fiber, ash and carbohydrate contents were determined according to A.O.A.C (10)

2.5 Sensory evaluation

Twenty panelists was used to assess the attributes of the ogi porridge such as taste, colour, odour, consistency and overall acceptability using nine point hedonic scale:1=Extremely Dislike to 9 =Extremely like according to Iwe, (11).

2.6 Statistical Analysis

Data was designed by multiple linear regressions using the method of least squares to fit the other equation to all responses for coefficient of determination [R^2] value, probably values, F-value and the regressions coefficients.

$Y = \beta_o + AX_1 + BX_2 + A^2X_1^2 + B^2X_2^2 + ABX_1X_2$ .....

Where β_o, A-B, A^2-B^2_2 and AB are the equation interaction coefficients respectively, $X_1 - X_2$ are coded independent variables (12).

III. Results and Discussion

3.1 Effect of Moisture Content on the Dried Ogi Spiced with Cloves

The effect of moisture content on the dried ogi spiced with cloves are shown in the interaction graph in Figure 1. The moisture content ranged from 6.0 - 11.30 %. The model ($R^2 = 0.80$) had a positive quadratic term (maize and cloves) and a negative linear term (maize and cloves). The moisture content was significantly affected ($P < 0.05$) by A^2 and B^2 (quadratic terms of maize and cloves). As the quantity of maize increases, there was a significant increase in the moisture content of dried ogi spiced with cloves. Moisture content determines the shelf life of a food product because the higher the water activity, the more susceptible the food will be to interactions with microbes and its environment (13). The values are within the range (6.54-11.20%) reported by Eke-Ejiofor and Beleya (14).

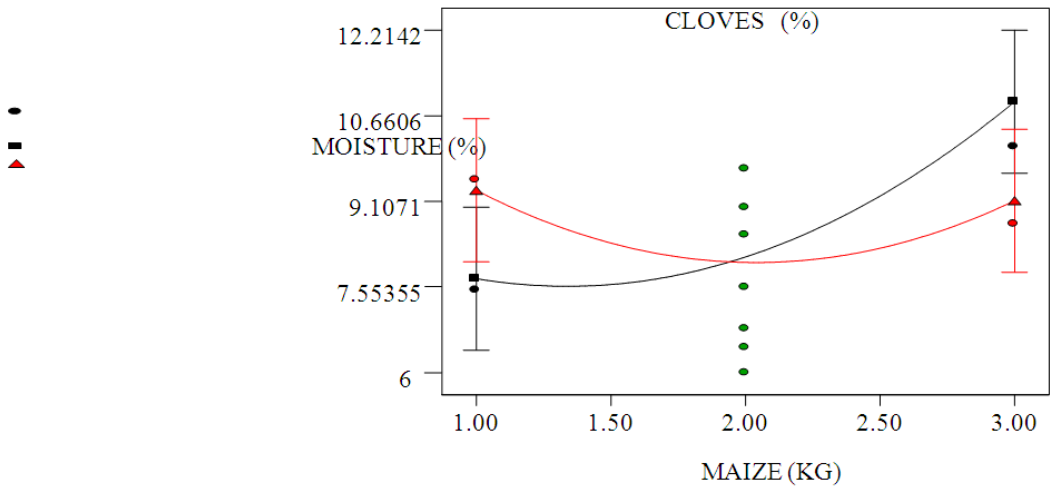

Figure 1: Effect of moisture content on dried ogi spiced with cloves

3.2 Effect of Protein Content on the Dried Ogi Spiced with Cloves

The effect of protein content on the dried ogi spiced with cloves are shown in the interaction graph in Figure 2. The protein content ranged from 5.40 - 10.60 %. The model (R^2 = 0.95) had a negative quadratic term (maize and cloves) and a positive linear term (maize and cloves). The protein content was significantly affected ($P< 0.05$) by A^2 and B^2 (quadratic term of maize and cloves). As the quantity of maize increases, there was significant increase in protein content of dried ogi spiced with cloves. There was a significant increase in protein content of the samples probably due to high protein in cloves as reported by USDA, (15). This increase shows an improvement in the quality of the dried ogi samples.

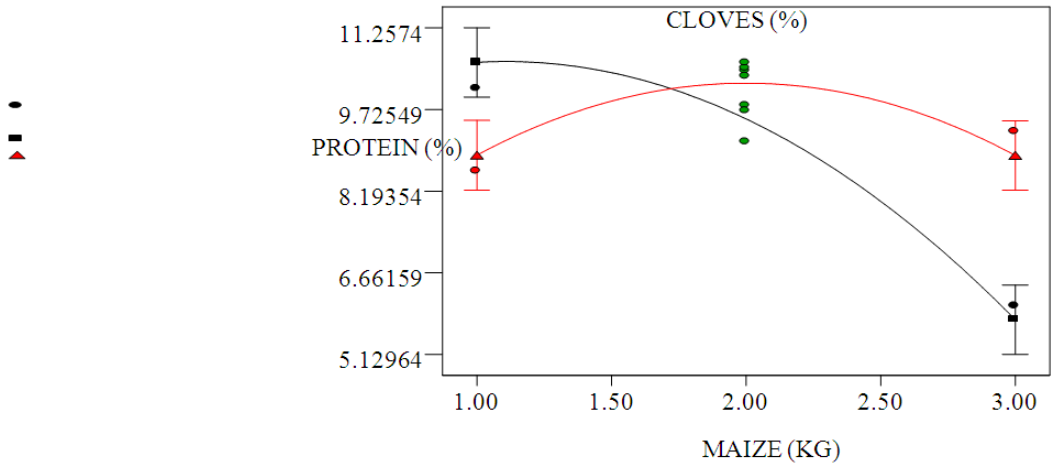

Figure 2: Effect of protein content on dried ogi spiced with cloves

3.3 Effect of Fat Content on the Dried Ogi Spiced with Cloves

The effect of fat content on the dried ogi spiced with cloves are shown in the interaction graph in Figure 3. The fat content ranged from 0.5 - 1.35 %. The model (R^2= 0.77) had a positive quadratic term (maize and cloves) and a negative linear term (maize and cloves). The fat content was not significantly affected ($P> 0.05$) by A^2 and B^2 (quadratic term of maize and cloves). There was decrease in fat content of dried ogi spiced with cloves as the quantity of maize increases, while there was significant increase in fat content as the quantity of the cloves increases. The low fat content may be as a result of processing, because processing operations such as milling, steeping and sieving results in reduction of nutritional content (16). The increase in fat content could be due to high fat in cloves (13g) as reported by USDA, (15). The values were lower compared to values (3.13-4.48%) reported by Eke-Ejiofor and Beleya (14).

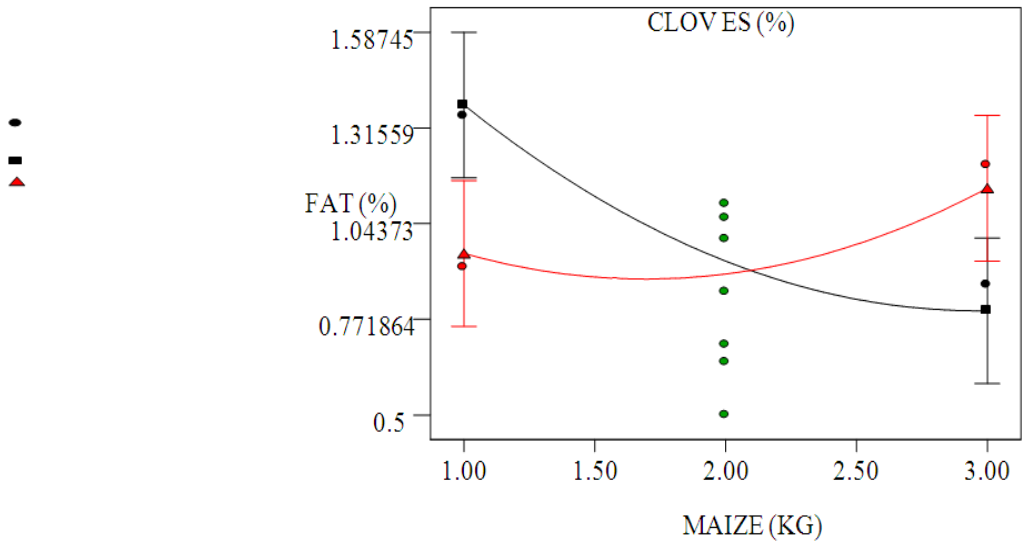

Figure 3 : Effect of fat content on dried ogi spiced with cloves

3.4 Effect of Crude Fiber on the Dried Ogi Spiced with Cloves

The effect of crude fiber content on the dried ogi spiced with cloves are shown in the interaction graph in Figure 4. The crude fiber ranged from 3.01 - 5.23 %. The model (R^2= 0.95) had a positive quadratic term (maize and cloves) and a positive linear term (maize and cloves). The crude fiber was significantly affected (P< 0.05) by A^2 and B^2 (quadratic term of maize and cloves). As the quantity of maize and cloves increases, there was variation in the crude fiber of dried ogi spiced with cloves. Crude fiber is a measure of the quantity of indigestible cellulose, pentosans, lignin and other components of this type in present foods (17).

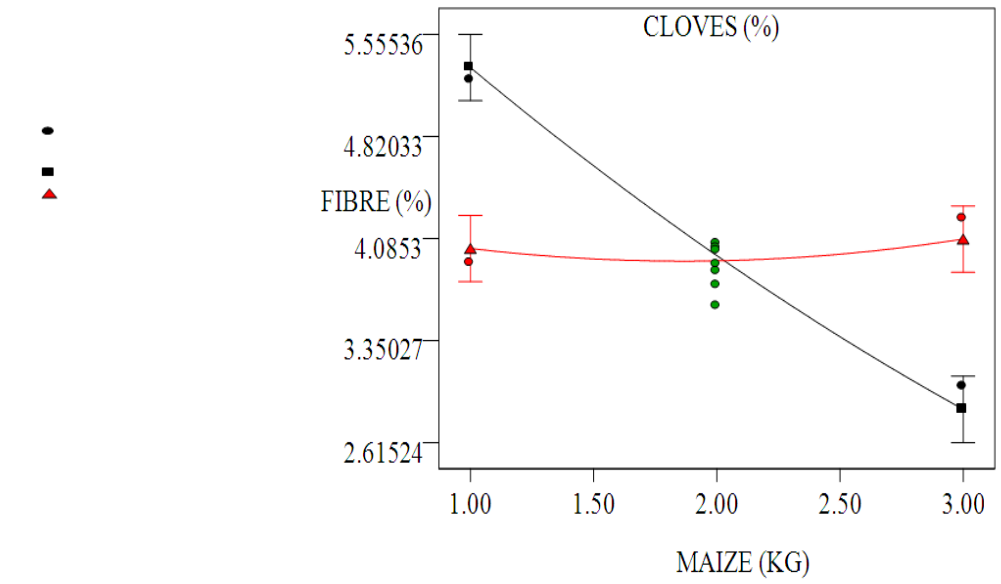

Figure 4: Effect of crude fiber on dried ogi spiced with cloves

3.5 Effect of Ash Content on the Dried Ogi Spiced with Cloves

The effect of ash content on the dried ogi spiced with cloves are shown in the interaction graph in Figure 5. The ash content ranged from 0.52 - 1.13 %. The model (R^2= 0.77) had a positive quadratic term (maize and cloves) and a positive linear term (maize and cloves). The ash content was significantly affected (P< 0.05) by A^2 and B^2 (quadratic term of maize and cloves). Ash is a measure of the total amount of minerals present in a food sample. As the quantity of maize and cloves increases, there was variation in ash content of dried ogi spiced with cloves.

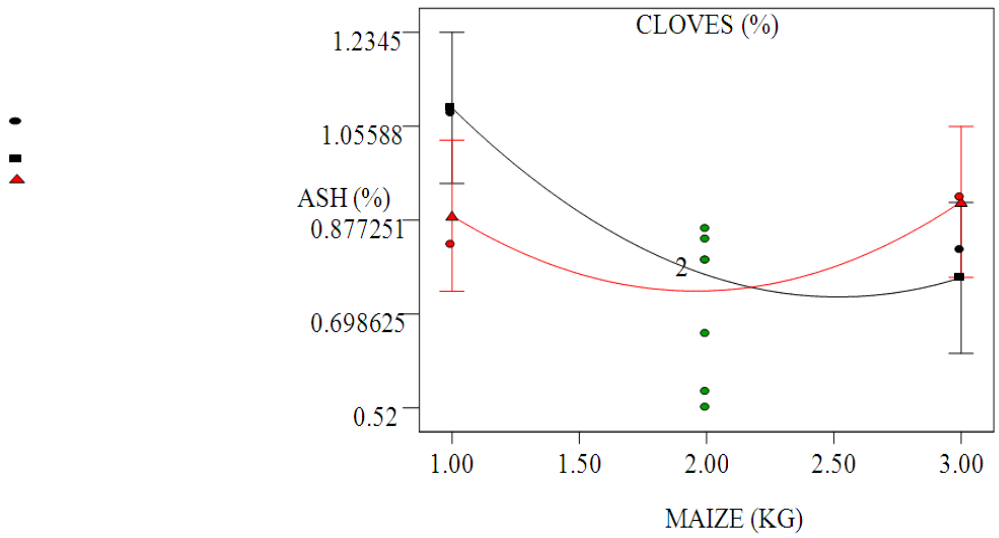

Figure 5: Effect of ash content on dried ogi spiced with cloves

3.6 Effect of Carbohydrate Content on the Dried Ogi Spiced with Cloves

The effect of carbohydrate content on the dried ogi spiced with cloves are shown in interaction graph in Figure 6. The carbohydrate content ranged from 72 - 79.15 %. The model (R^2= 0.85) had a positive quadratic term (maize and cloves) and a negative linear term (maize and cloves). The carbohydrate content was significantly affected (P< 0.05) by A^2 and B^2 (quadratic term of maize and cloves). As the quantity of the maize increases, there was significant increase in carbohydrate content of dried ogi spiced with cloves.

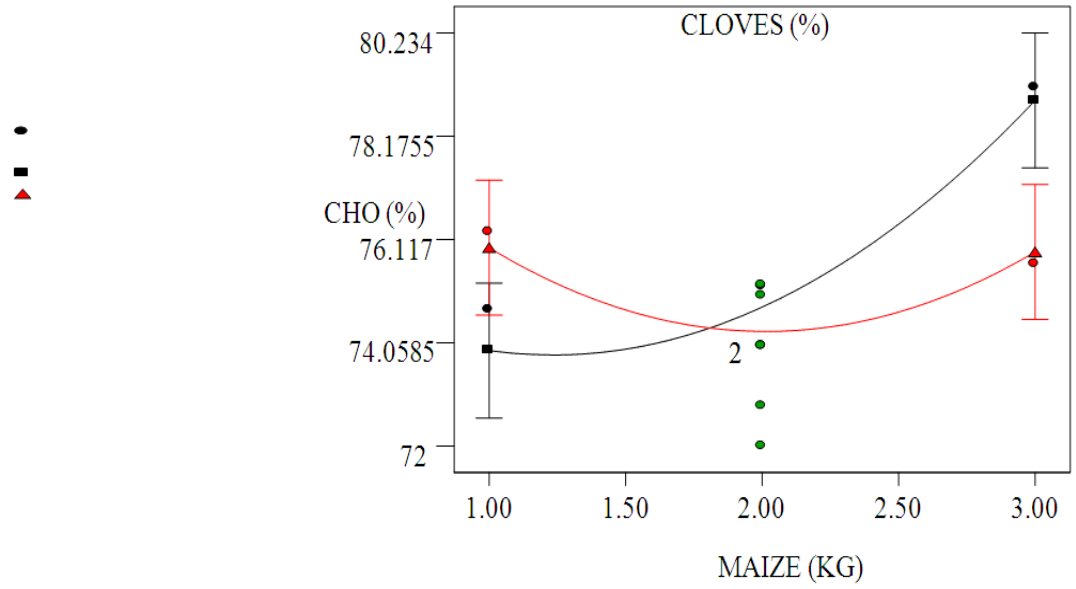

Figure 6: Effect of carbohydrate content on dried ogi spiced with cloves

3.7 Effect of overall acceptability on the dried ogi Spiced with cloves

The effects of overall acceptability on the dried ogi spiced with cloves are shown in interaction graph in Figure 7. The overall acceptability ranged from 6.2 -7.4. The model (R^2 = 0.94) had a negative quadratic term (maize and cloves) and a negative linear term (maize and cloves). The overall acceptability was significantly affected (P< 0.05) by A^2 and B^2 (quadratic term of maize and cloves). There was significant increase in overall acceptability of dried ogi spiced with cloves as the quantity of the maize increases with the addition of cloves.

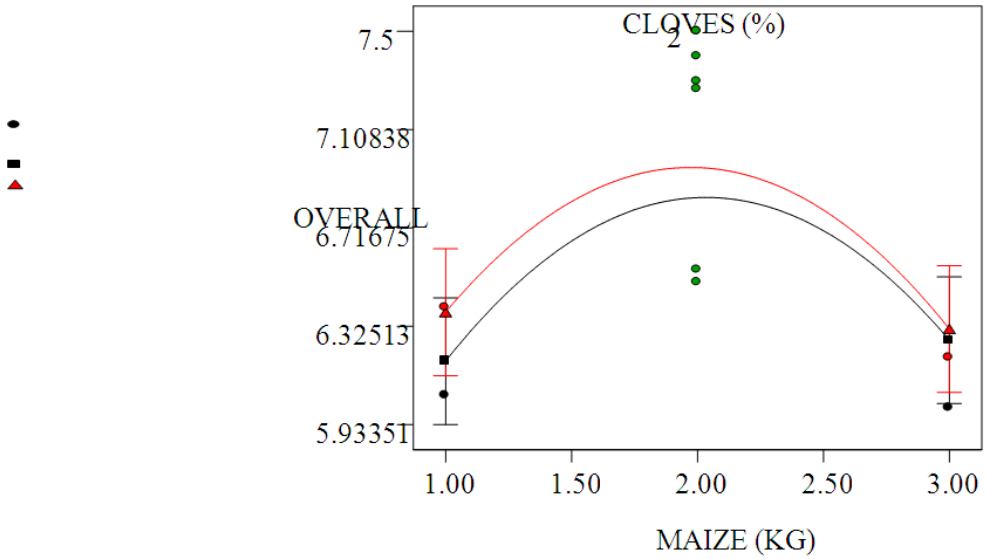

Figure 7: Effect of overall acceptability on dried ogi spiced with cloves

Table 1: Regression Coefficient and Analysis of Variance of Regression Model

Coefficient	Moisture Content (%) Y_1	Protein Content (%) Y_2	Fat Content (%) Y_3	Crude Fibre (%) Y_4	Ash Content (%) Y_5	Carbohydrate Content (%) Y_6	Overall acceptability Y_7
β0	+11.9*	+ 9.78***	+ 3.46	+9.18***	+2.38*	+77.52**	+1.93***
A	– 2. 11*	+ 1.39***	– 1.15	-2.57***	-0.90	-2.32**	+2.53
B	– 9.86	- 0.08	– 4.12	-6.20	-2.06	-7.37	+8.18
A^2	+ 1. 21**	- 1.35***	+ 0.15	+ 0.12	+0.16**	+1.63**	-0.61***
B^2	+ 10.98*	- 4.88*	+ 1.99	+1.37	+1.02	+10.72*	-5.52***
AB	– 2. 83	+4.02	– 0.64	+2.11***	+0.29	- 4.23	-0.13
R^2	0.80	0.95	0.77	0.95	0.77	0.85	0.94
F value	5.54	26.02	4.64	28.51	4.78	7.97	21.12

Significant level*** 0.001, ** 0.01, * 0.1

IV. Conclusion

The results obtained from this study indicated that there was significant increase in protein and fat contents of dried ogi spiced with cloves with decrease in moisture and carbohydrate as the quantity of maize and cloves increases. The ogi produced from 3.00kg of maize and 0.40g of clove was most preferred by the panelists. The addition of cloves greatly increases the nutritional content of the dried ogi.

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