COMPOSITE FLOUR DEVEWPMENT FOR INJERA

Haregewoin Cherinet, S.R.N, BSc, MPH

ABSTRACT: A composite flour has been developed to simulate an expensive cereal grain, tef (Eragrostis tef) for making injera, by incorporating cheaper grains. Sixty four combinations were baked, their physical characteristics and shelf-life tested. The results were statistically analyzed using mean scores of texture, elasticity , and reconstitution properties. The triangle and duo-trio tests were used for panel selection; paired
comparison preference and declared control difference tests were employed for sensory evaluation, and the best composite flour to imitate tef was a combination of [tef 35% wheat (Triticum durum) 25% and sorghum (Sorghum vulgare) kafir group 40%]. The nutritive value of the new product correspond with that of tef and a 27% cost reduction was accomplished for each injera. [Ethiop. J. Health Dev. 1993;7(2):71-77]

INTRODUCTION

Injera, a fluffy honey-comb structured flat bread, is one of the Ethiopian staple foods, mainly prepared from tef (Eragrostis tef) an indigenous cereal grains. It is a popular and nutritious food, with long shelf-life, distinct and preferred characteristics of texture and flavour, and simplest to prepare. Tef grain can be conserved for many years without any appreciable change or damage from insect pests, if vermin and moisture are excluded from storage bins (1). Constraints to tef's increased production and consumption are the high labour input for production and low yield/unit area compared with other cereals. This has led the supply of tef to fall short of demand, and the grain has become the most expensive cereal in Ethiopia. Nevertheless, injera has broad cultural implications for the Ethiopian society and there is always a need to hold on to it (2).

Until such a time comes when the supply of tef is increased and thus prices reduced, alternative cereals must be used for the making of injera. though injera can be prepared from other cereals like sorghum, barley, maize and wheat, the acceptance of such a substitute is only limited to certain areas. Thus, it is rational to try to develop a composite flour formula, for injera preparation, which retains the more widely preferred characteristics of the original product and incorporate less expensive ingredients. The objective of the study was to identify and develop a formula for the preparation of a widely acceptable injera.

Based on the findings of this study, it was intended to teach local women of the mixture so that they would be able to make it at home, and produce promotional material to popularize the new product. The main question in this research was therefore to find out which cereals to combine and in what proportion, to imitate tef injera in appearance and flavour, as well equate in nutritive value.

METHODS

The study was conducted by the Addis Ababa University at the Awassa College of Agriculture, Department of Home Economics. Cereals were bought from a nearby grain marked, preparatory operations were carried
out by local women using traditional equipments and the grain was ground into tine powder in a local flour mill. Sixty four mixtures were prepared for baking using tef, wheat, sorghum, barley and maize. A semi-solid dough was prepared by mixing 5 to 6 kilograms of a given flour with luke

warm water and kneading it thoroughly for about 30 minutes adding little water at a time. This was then seeded with about 400 ml of starter 'ersho' or wild yeast, and left to ferment for 24-48 hours. Mixtures containing larger proportions of 'tef' were left for longer hours -the maximum is stated in the above mentioned duration of hours. The 'ersho' was
a fermented dough of 'tef' .A second fermentation was initiated by the addition of 'absit' (a paste/gel) made by mixing about 500 ml of the fermented dough with about 1500 ml of boiling water and heating it until thickened. A total of 30 pieces of injera were baked on electric-powered flat pan of clay, the 'mitad' and the following tests carried out.

Institute of Development Research P.O.Box 1176, Addis Ababa University Addis Ababa.

Visual Observation: Injera samples baked from the 64 types of flour were all examined, and physical resemblance with injera from 'tef' was inspected and those found to be totally different were rejected.

***Number of Eyes*:** Eyes were counted at four randomly selected sites, using a 3x3cm frame, and the average for the pieces of injera worked out. Ideally, eyes should neither be too few nor too numerous, they must be rather deep, interlocked with thin cross-walls between them and evenly distributed. Since a higher or lower score is not necessarily a sign for a better quality, those samples with 11-15 eyes/cm2 were accepted. Smoothness of Back: This was observed on the samples along-side the counting of the eyes, it was done by looking and following with the hand; and scores of 0 to 6 were recorded. Samples were then divided into two batches of 15 pieces each, one batch was used to test texture and elasticity , and the other to test reconstitution property .

Texture, Elasticity and Reconstitution Property: These were judged either by the feel of the hand or looking, and scores between 0 and 6 were recorded. Oven-dried samples were broken into small pieces, placed in a dish, boiling water was added and drained out immediately. The dish was kept covered for 15-20 minutes and observed as to how well the reconstituted product resembled the original sample. Texture was taken as the most important parameter and samples with a mean score of 4.00 and above (moderately fluffy or better) were selected. The mean scores for elasticity, smoothness of back and reconstitution property were calculated. The total average including texture was determined, and samples with a score of 3.5 or above and
number of eyes 11-15 eyes/cm2 were categorized acceptable. Subjective tests (ie. smoothness of back, texture, elasticity , and reconstitution property) for the initial selection were carried out by the author. Later, taste panellists were involved in carrying out tests on smoothness of back, texture and elasticity, and sensory
evaluation. It was not found to be practical to make panellists do reconstitution property . Statistical Analysis: The mean scores of the subjective tests were used as a standard for comparison of results. In the case of number of eyes, 11-15 eyes/cm2 was accepted by basing the observation on practical experience. Cost, Processing Loss and Labour: Samples containing 50% and above of 'tef- the most expensive cereal, or barley -the cereal with the highest processing loss and took the longest time for cleaning were rejected.Sensory evaluation was conducted on those selected.

Table **1 Cost Estimation of One Injera in Birr**

Grain	Price/100 kg	Processing Loss (%)	* Yield Injera/kg.	Price/Injera

Tef	88.50	3.0	6.01	0.15
Wheat Sorghum (k)	57.00	10.0	6.44	0.10
Zengada Sorghum (F)	45.65	15.0	6..96	0.09
Mashilla	55.60	5.0	5.49	0.11
Barley	69.10	25.0	7.14	0.13
Maize	33.30	5.0	5.80	0.06
New Product				
Tef 35%				
Wheat 25%				
Sorghum (k) 40 %	63.50	9.5	.04	0.11

- 400 g was taken as the standard weight for one injera in calculating yield injera/kg. Based on experiments in this study.

Note : calculation of price for one injera was basde on the prevailing price of cereals at the time of the research, labour and fuel cost have not been included.

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Table 2: **Nutritive Value of Different Cereals in Terms of 100g of Edible portion**

Cereals	Moisture (g)	Protein (g)	Fat (g)	Carbo hydrate (g)	fibre (g)	Iron (mg	Food Energy Calories
Tef (white)	10.4	11.1	2.4	73.6	3.0	18.9	339
Flour	10.9	9.3	2.4	74.9	2.0	23.4	338
(mixed)	10.7	8.3	2.9	75.2	3.6	59.0	336
Wheat (white)	10.8	10.3	1.9	71.9	3.0	7.5	339
Barley (whole grain)	11.3	9.3	1.9	75.4	3.7	10.2	334
Flour	9.2	10.8	2.4	74.3	3.7	15.9	334
Maize (whole kernel)	12.4	8.3	4.6	73.4	2.2	4.2	356
Flour	10.0	8.3	4.7	75.9	2.1	10.3	366
Sorghum							
Mashilla	12.1	7.1	2.8	76.5	2.3	7.8	338
Zengada	12.4	7.1	3.1	75.6	3.7	9.6	338
* Flour of							
35% Tef							
25% Wheat	11.3	8.3	2.7	74.6	3.5	26.4	356
40% Zengada							

Source: Food Composition Table for use in Ethiopia(6).

- Calculated from nutritive values in the Food Coposition Table .

Table 3: **Extent of Acceptance of Injera from different Combinations containing cheaper grains.**

Samples accepted after tests					
Combinations		Visual		(texture Elast[1] backsde,	Cost, pro.[2]
Containing	Total	Observation	Text[3]	Rec. [4] prop.[5] No of eyes)	Loss, time
Sorghum (k)	14	13	13	6	3
Zengada					
Sorghum (F)	12	10	4	1	1
Mashilla					
Maize	13	10	4	1	0
Sorghum (K) and Maize	6	5	2	2	2
Sorghum (F) and Maize	5	4	1	0	0

[1] elasticity [2] Processing [3] Texture [4] Reconstitution [5] Property

Sensory Evaluation: The triangle and duo-trio tests were used for panel selection; paired comparison preference and declared control difference tests were employed for sample selection (3,4,5). Fifteen panellists were selected from a predominantly female population including renown cooks, believing that women would be better able to detect slight flavour changes than men. All tasting was done by panellists and scores given according to instructions. The score for each sample was then computed and final comparison
made.

The limitation of the research was the inability to conduct many of the tests using scientific equipment, in addition to the scarcity of available literature which had made reference and comparison difficult. This is because of the very limited number of researches on this subject.

RESULTS

Visual observation showed that 10 of the 64 baked products did not resemble injera as known traditionally or were too fragile or sticky. Of the remaining 54 samples, 14 scored a mean of 3.5 or above in the subjective tests with the number of eyes ranging from 11 to 15 eyes/cm2, and were accepted. After considering cost, processing loss and labour, 6 samples were selected from the 14. Paired comparison preference test was conducted introducing 2 samples at a time, and those underlined are the samples preferred.

a. 1. Tef 25% Sor"hum (k) 50% Wheat 25%
2. Tef 25% Sorghum (k) 50% Barley 25%
b. 3. Tef 25% Barley 25% Sorghum (k) 25% Maize 25%
4. Tef25% Wheat 25% Sorghum (k) 25% Maize 25%
c. 5. Tef 34% Wheat 33% Sorghum (t) 33%
6. Tef 35% Wheat 25% Sorghum (k) 40%

Key: Sorghum Vulgare feterita troup Sorghum Vulgare kafir troup

Finally,declared-control-differencetest was conducted using tef as the standard, and comparing each of the selected samples with tef, and the following scores were give: 5 = same as standard; 4=slightly different from
standard; 3 =moderately different from standard; 2 =very different from standard; 1 = extremely different from standard; The scores for the three samples were: (1) tef 25% + wheat 25% +

sorghum (k) 25% + maize 25% = 3.00; (2) tef 25% + wheat 25% + sorghum (k) 50% = 3.41; .(3) tef 35% + wheat 25% + sorghum (k) 40% =3.66.

Therefore, the sample consisting of tef 35% + wheat 25% + sorghum (k) 40%, was found to be the best of the three. The two highest scores went for tef, wheat, and sorghum (k) combinations.

Cost of One Injera: Table 1 shows the average price of cereals, processing loss, yield of injera per kilogram of flour, and in the last column, the price of one injera for each cereal grain and the composite flour. Comparison of the price of tef injera with that of the composite flour shows that there is a difference of Birr, 0.04 (4 cents) for each injera, a cost reduction of about 27% .

Nutritive values were calculated using data from food composition table for use in Ethiopia (6), and the new product equated tef,(Table 2).

DISCLSSION

Composite flour development had also been tried by other researchers and the results recorded were satisfactory but the parameters used were not shown. At the Institute of Agricultural Research (IAR), Agro-
engineering, Home Economics and Food Technology Department (7) 1: 1 mixtures of cereals were developed. Tef/pulse combinations in the ratio of 3: 1 also showed satisfactory results, except in the cases of
lentils and mung beans. No report was available on a research done at the Ethiopian Nutrition Institute combining tef and Sorghum vulgare kafir group (8). The use of fermented dough of tef for a starter and hence the involvement of the same types of microorganisms in all samples at the initial stage of the fermentation process, did not cause any problems with any of the flours. In the fermentation of 'tef dough, the engagement of two groups of microorganisms have been identified by other researchers. The groups were those that belong to the genera Saccharomyces and Torulopsis (9), gram negative aerogenic rods and Bacillus Suptilis ,
lactic acid bacteria and yeast (10); and Enterobacteriaceae (11).

The cheapest composite flour would have been that incorporating a high proportion of maize followed by sorghum. Results however showed that, of the 64 combinations, those containing a higher proportion of maize were rejected at the initial stage of the investigation (Table 3).

Since data on storage loss of the different cereal grains were not available, it has not been possible to consider this important parameter in the study. Tef is known for its storage stability and thus the price reduction achieved may not have importance. If that is the case, the long term solution would lie in the attempt to improve the yield per unit area of the tef grain.

ACKNOWLEDGEMENTS

The author is grateful to Dr. Geremew Haile and Dr. Aregay Waktola of Addis Ababa University for their invaluable consultation services, her colleagues Firdu Azerefegn and Asfaw Mesfin for a limitless assistance.
Special thanks goes to the Food Policy and Nutrition Division of the UN's Food and Agriculture Organization (F AO) for financing the project.

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