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Effects of Fermentation on Proximate and Anti-Nutritional Factors of Ogi Solid Waste.

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ABSTRACT

The fermentation of ogi is one of the oldest and cheapest biotechnological methods used in reducing its anti-nutritional components and increasing its nutritional value. This study evaluated the effect of fermentation on proximate and anti-nutritional factors of selected cereal solid waste. This study aimed to determine the microorganism involved in fermentation, evaluate the influence of fermentation on some proximate and anti-parameters in fermented and unfermented ogi solid waste. Although some fungi, bacteria, and yeast were presumptively identified from unfermented samples, the fermented samples had microorganisms with probiotic potentials. Also, the anti-nutritional value reduced and proximate analysis increased significantly ($p<0.05$). The consumption of ogi solid waste without proper fermentation may constitute a potential health hazard to livestock and humans,

Keywords: Fermentation, Cereals, Ogi, Solid waste, Anti-Nutritional Factors

1. INTRODUCTION

Cereal-based foods are a major source of inexpensive dietary energy, and basic nutrients in many developing countries (Adedire et al. 2017). They are processed in various ways, the most popular being through fermentation, which is an affordable technology for the preservation, and improvement of high carbohydrate-based foods (Opere et al. 2012). One of the popular indigenous fermented cereal-based foods in West Africa is Ogi, which is usually wet-grinded and sieved while the unfermented ogi bran is discarded into the environment, used to feed livestock (Agbabiaka and Madubuko 2013) or a supplement to other human food to aid bulkiness. (Fasasi et al. 2007) reported that cereal waste is high in fibre and has other nutritional qualities like protein, lipids, moisture, ash, and carbohydrate. However, some hazardous anti-nutritional components like tannin, oxalate, and phytate have been reported in the ogi unfermented solid waste, but low-cost, high-value, and socially and culturally acceptable ethnic, fermented foods are consumed in diverse forms (Tamang 2010). The objective of this work is to determine the microorganisms involved in fermentation, evaluate the proximate analysis and anti-nutritional component in fermented ogi solid waste.

2. MATERIALS AND METHODS

2.1 Sample collection
Maize-Zea mays (white and yellow varieties), sorghum -Sorghum bicolor (white and red varieties), and Pearl millet (Pennisetum glaucum L.) were purchased and transported in sterile polythene bags from Igbona market, Osogbo, Osun State, Nigeria to the laboratory for immediate processing. The agar and chemicals used for the study were purchased from Oxoid and Sigma-Aldrich.

2.2 Preparation of ogi solid waste
All experiments were carried out in triplicates.
Ogi was prepared according to the modified method of (Ajayeoba et al. 2016). Briefly, the cereal grains were cleaned of extraneous materials and individually steeped in a 5 L polypropylene plastic container with clean portable water for 72 h. The water was decanted, followed by three successive rinses in sterile distilled water. Each cereal was wet-milled individually in a Warring blender (7015N Model, Torrington, USA) for 10-15 min until a fine consistency was obtained. Each ogi sample was sieved using a muslin cloth and the ogi solid wastes (chaff) divided into two portions. A portion was fermented by soaking in distilled water for 72 h while the other non-fermented portion (control) stored at 4 ºC until use.

2.3 Isolation and identification of microorganisms
Isolation of microorganisms from each ogi solid waste (fermented and non-fermented) followed the modified method described by (Ajayeoba TA and Ijabadeniyi 2019). Morphological identification, Gram staining and biochemical test (Motility test, catalase test, sugar test, gelatin test, urease test, and coagulase test) of selected isolates from fermented and non-fermented ogi bran were carried out according to (Cheesbrough 2006). Identities of isolates were further confirmed using API 50 CHL (bio-Merieux) test.

2.4 Proximate Analysis and Anti-nutritional parameters of Ogi Solid Waste
The proximate analysis (moisture content, lipid, crude fibre, ash, protein, carbohydrate) and some anti-nutritional parameters (tannin, phytate, oxalate) of fermented and non-fermented ogi solid waste were determined according to (AOAC 2007).

2.5 Statistical Analysis
Data obtained from the proximate analysis and anti-nutritional parameters were subjected to ANOVA and Duncan multiple range tests were used to separate the differences within the means. Statistical significance was defined at $p < 0.05$

3. RESULTS AND DISCUSSION

3.1 Isolation and Identification of microorganisms in ogi solid wastes.
Indigenous fermentation of food waste such as cereal solid waste enhances the organoleptic and preservative properties while improving their nutritional quality. While some mycotoxin fungi have been reported cereal-based product, various activities of microorganisms have been reported to have profound effects on the characteristics of the food (Blandino et al. 2003, Braide et al. 2018). The presumptive identification of the following microorganisms isolated from unfermented ogi solid waste includes; Aspergillus flavus, Paenibacillus pectinilyticus, Clavibacter michiganensis, Corynebacterium xerosis, Microbacterium oxydans, Paenibacillus cellulositrophicus, Corynebacterium durum, and Bacillus tequilensis. The role of microorganisms in the production of some are enormous. These cereals are usually contaminated on the field before harvest is during post-harvest operations, thus representing a significant source of food-borne pathogens, especially the aflatoxins, and other bacteria, depending on handling procedures (Thielecke and Nugent 2018).

In a similar study, (Kazanas et al. 1984) found that most cereals are naturally contaminated. Therefore, some microorganisms found in the unfermented portion in this study may represent a public health risk. The microorganisms identified in the fermented portion are Lactobacillus fermentum, Lactobacillus brevis, Pediococcus pentaceus, Weissella cibaria, Furthermore, the yeast identified include Candida albicans, Geotrichum candidum. Fermentation has been used over time to alter flavor, texture and to increase the shelf life of food products. Lactic acid bacteria (LAB) from several genera, including Lactobacillus, Streptococcus, and Leuconostoc are predominant in cereal-based fermented foods. (Achi 2005) also reported the identification of bacteria, particularly Lactic acid bacteria (LAB) which are Lactobacillus plantarum, Lactobacillus pentosus, Lactobacillus cellobiosus, Pediococcus pentosaceus and Leuconostoc mesenteroides from ogi. In a related study by (Ajayeoba TA and Ijabadeniyi 2019), LAB having probiotic properties was isolated from the ogi product. This study shows that lactic acid bacteria, through fermentation can reduce/eliminate some pathogenic microorganism significantly, as reported by (Ajayeoba et al. 2019).

The proximate analysis carried out showed that carbohydrate, ash, and protein was higher and significantly different ($p<0.05$) in fermented and non-fermented ogi solid waste (Table 1). (Kazanas et al. 1984) reported that natural fermentation of cereal grain can significantly increase the nutritive value of this grain because of the greater availability of component nutrients: lysine, leucine, isoleucine, methionine, niacin, thiamine, and riboflavin. The availability of protein and starch was also increased in fermented cereals after enzymatic action. There was a significant increase in the lipid content, crude fibre after fermentation of all the samples which is in agreement with the work reported by (Pikuda and Ilelaboye 2013). As observed in this study, it is clear that fermentation processes can have significant direct effects on the nutritive qualities of foods (McFeeters 1988).

Table 1: Percentage proximate analysis of fermented and non-fermented Ogi solid waste

Proximate analysis							**Anti-nutritional factor**		
Samples	Protein	Moisture	Lipid	Ash (%)	Crude fibre	CHO	TANNIN	PHYTATE	OXALATE
Sorghum vulgare N.F	14.15^{b}	6.45^{c}	6.10^{c}	3.13^{e}	6.25^{c}	64.15^{a}	0.60^{b}	0.94^{a}	0.06^{c}
White *Pennisetum typoideumt* N.F	13.75^{b}	9.85^{c}	3.35^{e}	2.83^{d}	5.74^{d}	69.85^{a}	0.23a	0.23^{a}	0.05^{b}
Colored *Pennisetum typoideumt* N.F	14.15^{b}	6.415^{c}	6.1^{c}	3.18^{e}	6.25^{c}	64.15^{a}	0.79^{a}	0.25^{b}	0.05^{c}
White *Zea mays* N.F	8.15^{b}	6.115^{c}	3.21^{d}	1.19^{f}	2.25^{e}	78.95^{a}	0.35^{b}	0.70^{a}	0.04^{c}
Yellow *Zea mays* N.F	7.90^{b}	6.01^{c}	3^{d}	1.51^{f}	2.00^{e}	79.67^{a}	0.39^{b}	0.44^{a}	0.05^{c}
Sorghum vulgare F	16.21^{b}	8.20^{c}	8.12^{c}	3.30^{d}	8.30^{c}	55.87^{a}	0.44^{b}	0.83^{a}	0.05^{c}
White *Pennisetum typoideumt* F	13.85^{b}	9.10^{b}	3.5^{d}	3.13^{e}	5.80^{d}	64.18^{a}	0.15^{b}	0.17^{a}	0.04^{c}
Colored *Pennisetum typoideumt* F	13.05^{b}	8.95^{c}	3.1^{f}	4.45^{e}	6.00^{d}	64.52^{a}	0.36^{a}	0.24^{b}	0.03^{c}
White *Zea mays* F	7.40^{b}	7.01^{b}	2.95^{c}	1.91^{c}	2.00^{c}	77.74^{a}	0.23^{a}	0.17^{b}	0.02^{c}
Yellow *Zea mays* F	7.95^{b}	6.89^{c}	2.8^{d}	1.70^{e}	2.90^{d}	77.76^{a}	0.26^{a}	0.21^{b}	0.04^{c}

Values having the same superscript within the same row are not significantly different ($p<0.05$) F= Fermented, N. F= Non-fermented

3. CONCLUSION

This study showed the presence of some lactic acid bacteria in the selected ogi solid-waste. Lactic acid bacteria have been known for their ability to reduce some pathogenic microorganisms in the fermented product by lowering the pH and releasing some extracellular substances into the media. Fermentation increased the proximate analysis and reduces the anti-nutritional factors of the cereal solid-wastes. Also, the protein, lipids, ash, crude fibre increased. Ogi solid waste has been used as a supplement in animal feeds and sometimes used to supplement some food material due to the economic challenges in the country. This study shows that the fermentation of these wastes can reduce the consumption of food-borne pathogens, increase its microbiological quality and reduce anti-nutritional components. This will further reduce food-borne diseases and their associated public health risks. Further research should be carried out on the waste to determine the shelf life, compatibility with other food products and the applications of fermenting microorganism in industrial settings.

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