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Comparative study of the growth of *Pseudomonas aeruginosa* strain PG1 in two Nigerian soups

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Abstract

Soup is a primary liquid food, made by combining ingredients of meat or vegetables with stock or water. Proximate composition and microbial load were evaluated after the inoculation of *Pseudomonas aeruginosa* strain PG1 to determine the growth rate in two Nigerian soups. The percentage proximate composition of 'ogbono' and native soup revealed the presence of moisture (9.60, 59.37), carbohydrate (28.97, 20.89), protein (18.42, 5.42), crude fibre (0.98, 1.15) lipid (34.62, 11.09) and ash (7.41, 2.98), respectively. Total count was lower in native soup with counts ranging from 5.27 to 9.83 log₁₀cfu/ml while 'ogbono' soup had microbial counts ranging from 5.29 to 10.92 log₁₀cfu/ml. Counts showed an exponential increase in *P. aeruginosa* strain PG1 from the 0 to the 8 hours after which decline was observed. The growth of *P. aeruginosa* strain PG1 in soups is greatly influenced by the nutritional quality of the food as observed in this study.

Keywords: *Irvingia gabonensis*, *Pseudomonas aeruginosa* strain PG1, soup, spoilage

Introduction

Soup is defined as a liquid food, usually savoury and generally served warm (but may be cool or cold), made by stewing ingredients such as meat, vegetables, and fish, often in a stock and with seasoning and chemical mixture [1, 2]. There are different types of soups in the different culture and tribes in Nigeria such as *afang*, *ewedu*, *ogbono*, *editan*, *egusi*, *ofe-nsala*, *white soup*, *okro*, *owo*, *Ila*, *Kuka*, amongst several others [3, 4].

Nigeria, being a multi-faceted nation of well over two hundred and fifty tribal groups covering six geo-political zones, exhibits high variation in the preparation and consumption of most Nigerian dishes and soups [2].

Soups and foods generally, by their very nature, are nutritious and metabolizable hence serve as suitable substrates for the growth and metabolism of a vast population of spoilage and pathogenic microorganisms [5], leading to the spoilage of contaminated soups. The shelf life of most soups is relatively short and preservation is mainly through reheating in rural communities and refrigeration in urban or suburban communities with fairly stable public power supply.

Irvingia is a genus of African and Southeast Asian trees in the family Irvingiaceae, sometimes known by the common names: wild mango, African mango, bush mango, 'dika' or 'ogbono'. They bear edible mango-like fruits, and are especially valued for their fat and protein-rich nuts.

'Ogbono' soup also known as 'draw' soup, is a Nigerian Igbo dish but consumed in some West African countries like Gabon and Ghana, made with ground dry 'ogbono' seeds [6, 7]. 'Ogbono' soup is very popular and the method of preparation differs from tribe to tribe. It is incredibly versatile and babies and toddlers are introduced to solids like 'fufu' pounded yam and 'eba' with 'ogbono', since the mucilaginous (slimy) texture like cooked okra and jute leaves ('Ewedu'), helps them swallow with ease. The nutritional composition of the seed indicated that it contains 8.65% protein, 14.1% carbohydrate, 2.1% moisture, 1.4% crude fiber, 16.8% ash, and 38.9% dietary fiber [6, 8]. Bamidele *et al.* [9] reported the percentage proximate composition of different formulation of Instant "Ogbono" powder mixed soup ranging as follows: moisture (6.20±0.41 to 14.36±0.25), protein (10.40±0.20 to 24.13±0.12), fat (20.13±0.20 to 56.41±0.41), ash (6.98±0.17 to 9.20±0.12), crude fibre (0.26±0.12 to 1.52±0.20) and carbohydrates (17.31±0.40 to 35.61±0.23) while Lawal *et al.* [10] reported a proximate nutrient composition of *Irvingia gabonensis* (Ogbono) soups as prepared in the South-West and South-South regions of Nigeria (% dry weight) as follows:

Crude protein 19.81 ± 0.13 and 21.76 ± 1.29 ; fat 36.86 ± 0.04 and 40.17 ± 0.97 fibre 3.15 ± 0.12 , 3.96 ± 0.26 ; carbohydrate 32.38 ± 1.62 and 24.95 ± 0.08 ; ash 7.12 ± 0.57 and 9.16 ± 0.49 , and, moisture 69.99 ± 2.19 and 70.81 ± 3.44 , respectively.

Rivers Native Soup is a gift from the riverine people of Rivers State in the Niger Delta Area of Nigeria. It is prepared with 'ofor' (*Pterocarpus soyauxii*) as its major constituent, which serve as a thickener and gives the soup its consistency. The soup is rich in flavour, healthy spices and protein enriched from the freshest seafood such as sea snails, periwinkles, crayfish and prawns or shrimps. Eruteya *et al.* [11] have reported a proximate composition such as moisture (78.02%), ash (1.65%), carbohydrate (4.95%), protein (5.32%), lipid (4.37%) and fibre (5.69%) for Rivers State native soup prepared using the traditional method.

Pseudomonas spp. which are the most heterogeneous and ecologically significant group of known bacteria are aerobic, gram-negative bacteria that are recognized as major food spoilage microorganisms [12, 13]. They are proteolytic and cause undesirable changes in meat especially when high populations are reached after prolonged refrigerated storage. *Pseudomonas* spp., have been implicated in the spoilage of Native-chicken Soup, 'Atama' (*Heinsia crinata*) Soup and Rivers State Native soup [11, 14, 15].

The study is therefore aimed at comparing the population dynamics of *P. aeruginosa* strain PG1 in these two Nigeria soups.

Materials and Methods

Sample collection

The 'ogbono' and Rivers State native soup ingredients comprising *Irvingia gabonensis* (Ogbono), *Pterocarpus soyauxii* (ofor), stock fish, cray fish, Cameroun pepper, 'uziza' and pumpkin leaves and condiments were purchased at the Choba Junction market, Port Harcourt.

The *Pseudomonas aeruginosa* strain PG1 was previously isolated from 'Atama' (*Heinsia crinata*) Soup [15].

Preparation of 'ogbono' soup

The soup was prepared using the customary method. Dika kernel ('ogbono', 65 g) stock fish (15 g), cray fish (5 g) and Cameroun pepper (4 g) were processed into powdery form. The 'pumpkin leaves (5 g) were shredded, washed and drained. About 50 ml of palm oil was mixed with the 'ogbono' and stirred to obtain a homogenous mixture. Water (1500 ml) was brought to boil in a cooking pot, a small quantity of the hot water was then added to 'ogbono' and mixed thoroughly before transferring to the boiling pot of water. The solution was stirred vehemently for 1 min to avoid clumps from developing. The mixture was allowed to boil for 5 min after which salt and seasoning (6g) were added to the mixture and allowed to boil for another 5 min. The vegetable was added and allowed to simmer for another 3 min.

Preparation of Rivers native soup

Fresh 50 ml of palm oil was heated in a pot for 1 min after which 'ofor' was added to the mixture and stirred for 1 min; then 1500 ml of water was added and allowed to boil for 5 min. cray fish (15g), Cameroun pepper (5g), stock fish (10g), salt and seasoning (6g) were then added to the mixture. The soup was allowed to boil for 5 min after which 'UZIZI' leaves (5g) was shredded into the pot and allowed to simmer for 3 min then brought down to cool.

Proximate analysis

The moisture, crude protein, crude fibre, crude fat, carbohydrate and total ash contents of the soup was analyzed using the method described by Association of Official Analytical Chemists' [16].

Microbiological analysis

The prepared soup samples (100mL) were transferred into conical flask and autoclaved after which the *P. aeruginosa* strain PG1 (10^8 McFarland standard) was introduced into the soup. The flask was shaken vigorously and 1 mL of the soup immediately dispensed into sterile 9 mL normal saline, followed by ten-fold serial dilution. The flasks were then placed in shaker incubator and 1 mL withdrawn at interval (2, 4, 6, 8 and 10 h) for serial dilution. Aliquots (0.1 mL) of appropriate dilutions were spread plated on Nutrient Agar and incubated at room temperature ($30 \pm 2^\circ\text{C}$) for 24 h. Discrete colonies were counted and calculated to obtain the colony forming units (CFU).

Results and Discussion

Proximate composition

Proximate composition of foods is crucial to the assessment of the nutritive quality of the food or any medium being evaluated [17] and its ability to support the growth of microbial contaminants.

The results of the proximate analysis of the soups with varying values for each parameter are presented in Table 1. The percentage moisture content was higher in Rivers State native soup (59.37%) compare the of 'ogbono' soup (9.60%). Crude fibre were the least component of the examined soups. The values recorded are an indication of the nutritive nature of the two soups and their potential to support the growth of both spoilage and pathogenic microorganisms.

Table 1: Proximate composition of the examined soups

Parameter	Ogbono soup (%)	Native soup (%)
Moisture	9.60	59.37
Carbohydrate	28.97	20.89
Crude fat	34.62	10.09
Crude fibre	0.98	1.15
Ash content	7.41	2.98
Crude protein	18.42	5.42

Crude fat having the highest percentage (34.62) for ogbono soup in this study is consistent with the reports of a number of authors [18, 19, 20]. Specifically, the value of crude fat in this study agrees with the 34.38 ± 0.37 reported by Fasogban *et al.* [19]. Crude fibre also had the lowest percentage occurrence (0.98) for ogbono soup consistent with the reports by three authors [3, 18, 19], with vary values of 1.80 ± 1.00 , 1.04 ± 0.60 and 5.10 ± 0.06 respectively. For the ogbono soup the carbohydrate and/or crude protein contents were next after crude fat, as previously reported by Okolo [18], Fasogban *et al.* [19] and Olusegun and Omolayo [20]. Olayemi and Rahman [3] however, recorded a very low value (1.90 ± 0.01) for carbohydrate.

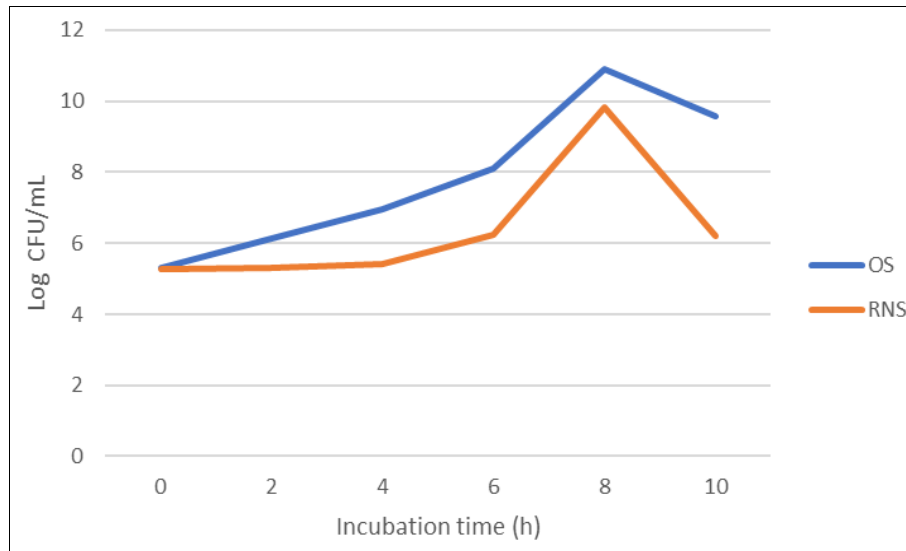
There is paucity of report on the proximate composition of Rivers State native soup save the previous report by Eruteya *et al.* [11]. The high moisture content of the native soup in the present study agrees with previous report by Eruteya *et al.* [11]. But for the crude protein value of 5.42% which is comparable to the value for this study, there were variation

in the values for all other parameters which may be occasioned by a possible varying amount of the ingredients used. Overall, the soup has appreciable values for carbohydrate, crude fat and crude protein like the 'ogbono' soup.

Growth of *P. aeruginosa* strain PG1 in soups

Nigerian indigenous soups are very rich nutritively in macro and micro nutrients essential to the human body metabolism [2, 21] and growth of microorganisms resulting in spoilage of

foods. The growth of *P. aeruginosa* strain PG1 in the two soups is presented in Figure 1. The growth of the bacterium was more pronounced in the 'ogbono' soup compared to the Rivers native soup. The growth count showed an exponential increase in *P. aeruginosa* strain PG1 from the 0 to 8 h after which decline in growth count was observed. This may not be unrelated to the variation in the available nutrient arising from the ingredients used in the preparation of the soups.



OS= 'Ogbono' soup; RNS=Rivers native soup

Fig 1: Growth of *P. aeruginosa* strain PG1 in the soups

Conclusion

In this study, it was observed that the growth of the *P. aeruginosa* strain PG1 in soups is greatly influenced by the nutritional content of the soups. The 'ogbono' soup with fairly higher nutritional content proved to be a better breeding ground than the Rivers native soup.

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