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Nutritional Properties of Cooked Instant Noodles Fortified with Annatto Seed Flour

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Abstract

Instant noodles are known for their consumption among the Nigerian population; their primary ingredient (wheat flour) is low in protein content, vitamin A and essential nutrients. Annatto is a monotypic genus of the family Bixaceace. The sensory attributes and nutritional effect of fortification of instant noodles with annato seed flour is thus investigated (proximate composition and vitamin A). The most acceptable sample is 3% ANNANOD (annatto seed flour and Instant noodles), annatto seed flour (ANNA) and cooked instant noodles (NOD) were subjected to further analyses. Proximate analysis was carried out using the method described by the Association of Official Analytical Chemist (AOAC). The nutrient constituents revealed that the crude protein contents were 16.97 ± 0.59, 13.67 ± 0.01, and 15.73 ± 1.53 g/100 g for ANNA, NOD and ANNANOD, respectively. The crude fiber contents were 11.64 ± 2.32 g/100 g for ANNA, 0.03 ± 0.01 g/100 g for NOD and 0.33 ± 0.01 g/100 g for ANNANOD. The moisture contents were 3.29 ± 0.02 g/100 g for ANNA, 5.31 ± 0.04 g/100 g for NOD and 5.64 ± 4.11 g/100 g for ANNANOD. The ash contents were 7.78 ± 1.32, 0.60 ± 0.03, and 0.72 ± 0.13 g/100 g for ANNA, NOD and ANNANOD, respectively. The level of Vitamin A obtained for ANNA, NOD and ANNANOD were 53,522.31, 19.00, and 456.72µg/g, respectively. It is evident, from this study that, fortification of instant noodles with annatto seed increased the proximate components and vitamin A contents of the noodles.

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Introduction

A micronutrient deficiency exacerbates one's health status and quality of life (Mayer *et al.*, 2018). According to the FAO (2013), over two billion individuals, or one in three people worldwide, suffer from such micronutrient deficiencies. These deficiencies arise when the intake or absorption of vitamins, proteins and minerals are insufficient to maintain good health and development of the body (FAO 2013). The Food and Agricultural Organization (FAO) estimates that over 795 million people or one in nine individuals globally, suffer from undernourishment, among these individuals, about 780 million, which accounts for roughly 98%, reside in developing nations (FAO 2013). Over the past four decades, agricultural research aimed at developing nations has successfully boosted the production and

accessibility of staple crops that are high in calories, but there has been a disproportionate lack of progress in increasing the production of non-staple foods, such as vegetables, pulses, and animal products, which are rich in essential micronutrients. In the long term, increasing the micronutrient foods and improving dieting diversity will substantially reduce micronutrient deficiencies (Bouis *et al.*, 2011).

Food is an essential requirement for survival. It serves as a primary source from which the body obtains its nutrients. When food is consumed, the nutrients such as minerals and vitamins can be assimilated by the body to provide energy, promote tissue growth, and nourish the body. Fast food is one of the major foods in Nigeria because it is convenient, readily available, quickly served and could be eaten on the go (Mojekwu, 2014). Most fast foods do not contain the necessary amount of nutrient needed by the body (Mojekwu, 2014). Examples of fast food are Pizza, Burger, Pastries, Spaghetti and Noodles.

Supplementation is a highly prevalent intervention commonly utilized in clinical and public health settings (WHO 2011). According to Imdad *et al*. (2010), it was found that this supplementation is beneficial in boosting the vitamin A levels of infants and children in underdeveloped countries, which in turn reduces the rates of illness and death, especially from diarrhea. The World Health Organization (WHO) currently recommends supplementation as a solution to public health issues (WHO, 2011). Fortification, as defined by the World Health Organization (WHO 2011) and the Food and Agricultural Organization of the United Nations (FAO: as the intentional process of increasing the levels of essential micronutrients, such as minerals and vitamins (including trace elements), in a food. The aim is to enhance the nutritional value of the food supply and promote public health, while minimizing any potential health risks (WHO and FAO of United Nations, 2016).

The most commonly used vitamin for fortification is foliate and the most commonly fortified food is wheat flour (WHO, 2011). Some plant extracts can also be used to fortify foods in order to enrich its nutrients. Examples of such plant is the use of baobab pulp used in fortifying rice cookies, (Mounjouenpou *et al.*, 2018), *Brassica Oleracea* used to fortify wheat flour and annatto (*Bixa orellana*) which can also be used to fortify food that are deficient in one nutrient or the other (Ebtihal *et al.*, 2017). *Bixa orellana L.*, often referred to as 'Sinduri' and 'Annatto', is a genus consisting of single species from the *Bixaceace* family.

The risk groups (women of child-bearing age, newborns and infants, refugees, and the sick and elderly) and the broader population in Nigeria are still under-nourished according to a UN report (2010). Although instant noodles is known for its high rate of consumption among Nigeria population (UN report (2010), its primary ingredient (wheat flour) which is not only low in protein content and fiber but also poor in essential amino acids (Cho *et al.*, 2010). Annatto seed is known to contain cellulose, sucrose, oils, fragrances and alpha and beta carotene (Paz *et al*., 2006). Its extract has been widely used as coloring agent both in food industries and other products and its residue was recorded to be rich in nutrients (Cho *et al.*, 2010). Extant literature revealed a minimal breakthrough in the use of Annatto seeds flour for cooked instant noodles fortification. Therefore, this study investigated. This research investigated the fortification of instant noodles with annatto seed.

Materials and Methods

Annatto seeds samples were purchased and air-dried for 24 hours after the dirty part has been removed. The dried sample was ground into pore size (dimension) using Silver crest multipurpose food processor (NO - SCV 606) and the powder was stored in an air-tight container. Instant noodles was procured and a sachet containing 65g of annatto seed was added into each five sauce pans containing 200 ml of boiling water and simmed for three minutes. The annatto seed powder was added (0g, 2g, 4g, 6g and 8g), respectively to the noodles in each sauce pan and allowed to cook for another two minutes according to Adegunwa *et al*., (2012). The constituent of each noodle samples are: 0g

of annatto seed flour with 65g of noodles, 2g of annatto seed flour with 65g of noodles, 4g of annatto seed flour with 65g of noodles, 6g of annatto seed flour with 65g of noodles and 8g of annatto seed flour with 65g of instant noodles.

Sensory Evaluation

Consumer approval of fortified instant noodles was assessed by a group of 20 semi-trained panelists from the Department of Food Science and Technology at Ladoke Akintola University of Technology, Ogbomoso. Fortified noodles, containing 2-8 grammes of annatto seed flour, were made and presented to the panelists with the unfortified noodles (0g of annatto with 65g of instant noodles). The purpose was to assess their sensory qualities through evaluation. Each of the five samples was allocated a random 3-digit number, and the order of the samples was randomized. The panelists were instructed to try each item and evaluate their overall preference before proceeding to the next one. In order to mitigate the carry-over impact, the panelists were provided with water to cleanse their materials used to serve.

A 9-point hedonic scale was used to measure sensory perception, with options ranging from extreme dislike to extreme liking. After a careful examination, numerical values were assigned to each description, where 1 represents severe dislike, 5 represents neither liking nor disliking, and 9 represents great liking. This was conducted in conjunction with a control group consisting of unfortified instant noodles in order to assess the attributes of colour, flavour, taste, texture, and overall acceptability.

The sensory evaluation was conducted on noodle samples prepared with varying proportions of annatto seed powder (0g, 2g, 4g, 6g, and 8g). The standard deviation and least significant difference at a 5% level of significance were calculated using the formula provided by the International Union for the Protection of New Varieties of Plants.

Calculation for standard deviation (S. D) and least significance difference at 5% level ($LD_{5\%}$)

$$S.D = \frac{\sqrt{Ed1^2 - (Ed)^2}}{n-1} \quad (3.1)$$

$$Ed1^2 = 1^2 + 1^2 \ldots + 1^2 = 30 \quad (3.2)$$

$(Ed)^2$= is the difference between the two samples (i.e. $12^2 = 144$)

$$T_{test} = \frac{(x-n)}{T} \ (\sqrt{n} \quad (3.3)$$

n = sample size
x = sample mean
N = population mean
T = population S.D

OR

$$Ttest = \frac{d}{s/\sqrt{n}} = \frac{d\sqrt{n}}{s} \quad (3.4)$$

d = mean difference
s = standard deviation

Hypothesis: -

Ho: - There is no significance difference between N_1 and N_2 (i.e. $N_1 = N_2$)

H_1 : - There is significance difference between N_1 and N_2 (i.e. $N_1 + N_2$)

Tx = Tvalue from statistical Table

Tvalue from statistical table

$t\frac{5\%}{2}$, 19 = 2.093

If Tcal>Ttab, then Ho is rejected i.e. there is significance difference between the compared samples at 5% level of significance.

LSD (least significance difference)

$$L.S.D. = t \text{ X } xsd \quad (3.5)$$

$LSD_{5\%}$, 2(n-1) = $t_{0.05}$, 38 = 1.684 (from statistical table).

Results and Discussion

Sensory Evaluation

Table 1 contains the result of findings on the sensory evaluation. Using color as sensory attribute, 3% ANNANOD (Annatto fortified noodles) has the highest value of 6.35 compared to 5.05 and 3.55 obtained for 6% and 9% ANNANOD, respectively. Meanwhile, 12% ANNANOD has the lowest value and this may be as a result from its appearance which was not attractive. The sensory score for taste ranges from 6.10 to 3.95, where 3% ANNANOD has the highest value of 6.1 compared to 5.15 obtained for 6% ANNANOD

while 12% has the lowest value. This may be due to the proportion of Instant noodles to the annatto seeds flour. Texture score ranges from 6.75 to 4.90. The highest score was recorded for 3% ANNANOD, followed by 9% and 6% ANNANOD, respectively. This may result from the choice of the panelist. Flavor is another sensory attribute which has the highest score 6.30 recorded for 3% ANNANOD compared to 5.05 and 4.60 obtained for 6% and 9% ANNANOD, respectively. The lowest value 3.35 was obtained for 12% ANNANOD and this may arise due to the choice of the panelist because annatto seeds has slight odour which can be observe at a very close range.

ANNANOD (3%) has the highest overall acceptability followed by 6% and 9% ANNANOD. This may be attributed to the difference in the proportion of the annatto seeds flour added to the noodles. The results obtained for sensory evaluation indicated that 3% ANNANOD was highly acceptable due to its attractiveness and delicious taste. The comparison between 3% and 6% ANNANOD noodles was represented in Table 4.2. However, the result revealed that there was significant difference in the color, taste, texture, flavor and overall acceptability of the samples at 5% level of significance.

Table 1: Sensory evaluation of ANNANOD fortified instant noodles

Samples	Color	Taste	Texture	Flavor	Overall acceptability
3% ANNANOD	6.35	6.1	6.75	6.30	6.75
6%ANNANOD	5.05	5.15	5.60	5.05	5.30
9%ANNANOD	3.55	4.4	5.9	4.6	4.75
12%ANNANOD	3.2	3.95	4.9	3.35	4.1

Key: 3%, 6%, 9% and 12% ANNANOD are 2g, 4g, 6g and 8g of fortified noodles, respectively

Table 2: Comparison of sensory evaluation between 2g and 4g of fortified instant noodles

Samples	Color	Taste	Texture	Flavor	Overall acceptability
3%ANNANOD	6.35	6.1	6.75	6.30	6.75
6%ANNANOD	5.05	5.15	5.60	5.05	5.30
SD	1.081	0.944	1.137	0.251	0.994
$LSD_{5\%}$	0.576	0.501	0.605	0.133	0.530
Tcal	5.378	4.500	4.523	2.272	6.524

Table 3 shows the comparison between 3% and 9% ANNANOD. It was discovered that there was high significant difference ($p \leq 0.05$) in the color, taste, flavor and overall acceptability of the samples. However, there is a slight difference in the texture of the samples at same level of significance.

Table 3: Comparison of sensory evaluation between 2g and 6g of fortified instant noodles

Samples	Color	Taste	Texture	Flavor	Overall acceptability
3%ANNANOD	6.35	6.1	6.75	6.30	6.75
9%ANNANOD	3.55	4.4	5.9	4.6	4.75
SD	1.735	1.182	1.790	1.129	1.654
$LSD_{5\%}$	0.925	0.630	0.953	0.600	0.880
Tcal	7.22	6.432	2.124	6.734	5.408

Table 4: Comparison of sensory evaluation between 2g and 8g of fortified instant noodles

Samples	Color	Taste	Texture	Flavor	Overall acceptability
3% ANNANOD	6.35	6.1	6.75	6.30	6.75
12%ANNANOD	3.2	3.95	4.9	3.35	4.1
SD	1.814	1.089	1.789	1.669	1.694
$LSD_{5\%}$	0.967	0.579	0.953	0.889	0.903
Tcal	7.766	8.829	4.625	7.905	6.996

Table 4 shows the comparison between 3% and 12% ANNANOD. It was discovered that there was high significant difference ($p \leq 0.05$) in the color, taste, texture, flavor and overall acceptability of the samples.

Proximate Composition

The results of proximate composition of the three samples are presented in Table 4.

The moisture contents observed were 3.29 ± 0.02 g/100g, 5.31 ± 0.04 g/100g and 5.64 ± 4.11g/100g for ANNA, NOD and ANNANOD, respectively. However, these showed that the three samples were significantly different ($p \leq 0.05$). The result obtained for NOD was higher than 2.98, 2.95, and 3.43 obtained by Suleiman *et al.*, (2020) for three different instant noodles sold in Sokoto. When these results were compared with moisture content of other seeds that have been used to fortify noodles (Hurrell *et al*., 2010), it was found to be within the range of 3.5 g/100g to 5.70 g/100g. The moisture content of these samples shows their shelf life can be prolonged because the values obtained are considerably lower.

The crude protein contents on dry weight basis of these samples are 16.97 ± 0.59 g\100g, 13.67 ± 0.01g/100g and 15.73± 1.53g/100g and for ANNA, NOD and ANNANOD, respectively. The results showed that there was no significant difference ($p \leq 0.05$) between ANNA and ANNANOD but NOD is significantly different ($p \leq 0.05$) from others and when compared with other seed such as *Brassica oleracea* that has been used to fortify noodles it was considerably higher, Dike *et al*, (2016) with the value 12.55 ± 0.28 g/100g. The result obtained for NOD was higher than 12.34 g/100g reported by Suleiman *et al*., (2020). These show that annatto seeds can complement other dietary sources of protein for the alleviation of protein malnutrition.

The crude fiber contents were between 11.64 ± 2.32 g/100g for ANNA, 0.03 ± 0.01 g/100g for NOD and 0.33 ± 0.01 g/100g for ANNANOD. This result showed that there is significantly different between ANNA and ANNANOD, ANNANOD is also significantly different ($p \leq 0.05$) from NOD. The values observed here are low compared to that of (Dike *et al*., 2016). Dietary fiber helps to lower cholesterol level, hypertension, and risk of coronary heart diseases, constipation, diabetes and cancer (Ishida *et al*., 2000).

The ether extract content of the samples were 2.18 ± 0.28 g/100g, 18.79 ± 0.01 g/100g and 14.30 ± 1.90 g/100g and for ANNA, NOD and ANNANOD, respectively. The three samples are significantly different from each other, sample NOD has the highest ether extract. The ether extract of annatto was considerably low to 7.20 ± 0.07 g/100g that was reported by Dike *et al*., (2016) and this shows a great impact for people that requires lesser fat in their diets because high amount of fat have implication on health related diseases and cardiovascular disorder (Antia *et al.*,2006).

Table 5: Proximate composition of the fortified noodles (g/100g) Dry Weight Basis

Group	Crude protein%	Crude Fibre%	Ether extract%	Ash%	Moisture%	Carbohydrate%
ANNA	16.97 ± 0.59^{b}	11.64 ± 2.32^{b}	2.18 ± 0.28^{a}	7.78 ± 1.32^{b}	3.29 ± 0.02^{a}	58.44±0.02^{a}
NOD	13.67± 0.01^{a}	0.03 ± 0.01^{a}	18.79 ± 0.01^{c}	0.60 ± 0.03^{a}	5.31 ± 0.04^{b}	61.60±0.01^{b}
ANNANOD	15.73 ± 1.53^{b}	0.33 ± 0.01^{a}	14.30 ± 1.90^{b}	0.72 ± 0.13^{a}	5.64 ± 4.11^{c}	63.28±0.01^{c}

Mean± standard deviation of the triplicate determined

Mean with the same superscript in the same column are not significantly different at 5% probability level.

Table 5 shows the ash content of the samples which were 7.78 ± 1.32 g/100g, 0.60 ± 0.03 g/100g and 0.72 ± 0.13 g/100g for ANNA, NOD and ANNANOD, respectively. The value for annatto is higher when compared with 5.62 ± 0.12 g/100g, Dike *et al*., (2016). ANNANOD had higher ash content compared with NOD, thus, this may be as a result of fortification. However both have lower values compared to the value (0.99 ± 0.01 g/100g) as reported by Suleiman *et al*., (2020). Therefore the use of annatto to fortify cooked instant noodles increased the proximate component.

KEY: Samples
ANNA = Annatto
NOD = unfortified cooked noodles.
ANNANOD = Fortified cooked noodles

Table 6: Vitamin A composition of ANNA, NOD and ANNANOD (µg/g)

Samples	β-carotene (µg/g)	%RDA in children (1-13 years)	%RDA in female / male adult)
ANNA	53522.31	300-600µg/day	700µg/day
NOD	19.00		
ANNANOD	456.72		

RDA: Recommended Daily Allowance
Source: Food and nutrition board (2011)

Vitamin A composition

The levels of vitamin A in the three samples were recorded in Table 6. Vitamins are organic compounds occurring in natural foods especially in vegetable and some plant seeds. They are needed for maintenance of skin, mucus, membranes, bone, teeth and hair, vision and reproduction (Rumeza *et al.*, 2006). Vitamin A is a fat soluble vitamin, it is often called retinoid. They include retinol, retinal, retinoic acids etc. It is needed

for the proper growth and functioning of many part of the body including the eyes, immune system, skin etc. The provitamin A which is beta carotene can be found in plants (Zhang *et al*., 2014). Vitamin A was found to be high in ANNA (53522.308 µg/g) and when 2g of it was added to 65g of cooked instant noodles the value was also high (456.715 µg/g) when compare with normal cooked instant noodles (19.004 µg/g), this results shows addition of annatto seed to instant noodles will increase the vitamin A composition of instant noodles and this in line with the recommended daily allowance (RDA) for children (300-600 µg/day) and adult (700 µg/day).

Conclusion

Annatto seed was observed in this study to add necessary nutrients (minerals, vitamin A, proximate and antioxidant) to instant noodles in order to enhance growth and maintain tissues. The low fat content when compared with the cooked noodles has a great impact for those that require less fat in their diets. The low moisture content indicates that their shelf-life can be prolonged. This research also revealed that addition of annatto seed to instant noodles increased Vitamin A composition and protein content of instant noodles. The mineral constituent was also increased when compared with the cooked noodles. The addition of annatto seeds flour to instant noodles will increase its nutritional quality and could complement the conventional one in enhancing food security and reduce micronutrient deficiency.

Recommendations

This research was limited to the determination of proximate analysis, mineral content, vitamin A and anti-oxidant analysis of fortified instant noodles. It is therefore recommended that further research will be required in the following areas:

1. Useful toxicity assay be carried out on this seed using animal experiment, the in vitro potential of the seed
2. Also cultivation of this seed should be encouraged because it can only be found in limited areas in Nigeria.
3. Instant noodles companies should also embrace the use of annatto seed to increase its nutrient.

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