ADEQUACY OF ROSELLE (SOBO) AS A SUBSTITUTE FOR ACID ORANGE IN COLOURING KILISHI

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Abstract

A three-phase study was conducted to evaluate calyx of Roselle plant sobo (Hibiscus sabdariffa) as a substitute for acid orange in colouring kilishi. In phase one, thirty kilishi producers were selected using convenience sampling and interviewed to obtain the concentration of acid orange used for colouring. In the second phase a spectrophotometer experiment was used to test various concentrations of sobo that will match the colour absorbance of the acid orange concentration obtained from phase one of the study. In phase three, two kilishi samples, one coloured with acid orange at the concentration obtained in phase one, the second coloured with sobo at the concentration that matched the concentration of the acid orange. Two sensory tests were used to compare the samples. The first test was to determine whether the samples were the same or different. The second test compared the samples for colour preference. The modal concentration of acid orange used by kilishi processors was 1.12 mg/ml and the sobo concentration that matched its absorbance (1.999nm) was 56mg/ml. There were significant difference in taste in taste and colour preference of the products. It is revealed that kilishi coloured with sobo is not an acceptable substitute for acid orange.

Keywords: Roselle plant (Hibiscus sabdariffa), kilishi, Acid orange, Preference, Processor

Introduction:

Kilishi is a Nigerian dry meat product prepared from beef, mutton, goat meat and other types of meat. In Nigeria, beef is mostly used for kilishi production (Igene et al., 1990). It consists of thinly sliced fresh lean strips/slice of muscle of about 0.17 - 0.5cm thick. The dry meat product kilishi is produced mainly in the northern part of West Africa (Alonge and Hiko, 1981) and is prepared by partially drying thin sheets of quality beef in the shade followed by marinating in a slurry of ingredients before a second period of sun drying and brief roasting (Igene et al., 1990). Kilishi is reported to consist of 46% meat and 54% non-meat ingredients and is composed of 50% protein, 18% fat, 9.6% ash and 7.6% moisture, the Kilishi product can be stored for over sixty weeks in dry environment (Kibon, 2006, Muhammad and Muhammad, 2007).

Curing ingredients used in Kilishi production include; clean water, defatted groundnut paste, salt, onions, sugar and spices like cloves, ginger, garlic, chili, black pepper and colouring material (Ogbonnaya and Linus, 2009) which contains high levels of triglycerides, phospholipids and polyunsaturated fatty acids and subsequently high amounts of malonaldehyde. It is also moderately acidic yet it has stable shelf life, which is enhanced by its low moisture contents and improved storage conditions (Igene et al., 1990; Chukwu and Imodiboh, 2009).

Food colorants are mainly applied to offset and overcome those unpleasant characteristics, as also to homogenize the colour of foodstuffs, through correction of colour variations and or enhancement of the naturally occurring food colour. The commonly used colouring material in Kilishi processing is a synthetic red pigment known acid orange II, called jawa in Hausa. As an industrial dye, jawa like any other acid dyes are water-soluble dyes employed mostly in the form of sodium salts of the sulfonic or carboxylic acids. They are anionic which attach strongly to cationic groups in the fibre directly (Daminabo et al., 2013).

They are applicable to all kind of natural fibres like wool, cotton and silk as well as to synthetics like polyesters, acrylic and rayon, but they are not substantive to cellulosic fibres. They are also used in paints, inks, plastics, paper coatings and leather. Bala (2018) reported that information obtained from the manufacturers within Sokoto metropolis showed that a gram of Kilishi contains an average of 1.2mg of acid orange. Acid orange II possess a chemical hazard when used to colour food for example in mammals azo-reductases are, with different activities,
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present in various organs like liver, kidney, lung, heart, brain, spleen and muscle tissues. The azoreductase of the liver, followed by the azo-reductase of the kidneys possesses the greatest enzymatic activity. After cleavage of the azo-linkage, the component aromatic amines are absorbed in the intestine and excreted in the urine (Agócs and Deli 2011). However, the polarity of azo dyes influences the metabolism and consequently the excretion.

Sulphonation of azo dyes appears to decrease toxicity by enhancing urinary excretion of the dye and its metabolites. Sulphonated dyes, mainly mono-, di- and trisulphonated compounds are world-wide permitted for use in foods, cosmetics and as drugs for oral application. As several of the degradation products of the dyes have been found to be mutagenic or carcinogenic and subsequently, some dyes were no longer permitted as food dyes (FOOD-INFO, 2017).

Natural food colorants revealed to be as much effective as those derived from chemical synthesis, with the subsequent benefits of: being more safe, providing health benefits besides conferring organoleptic features, exerting two or more benefits as food ingredients (in fact several food additives exerting colorant effects also act as antioxidants and even preservatives), they also contribute functional properties to food products (Carocho et al., 2014; Delgado-Vargas & Paredes-Lopez, 2003; Rodriguez-Amaya, 2016). Sobo is a dehydrated water extract of the calyx of the Roselle plant (Hibiscus sabdariffa). It is a name that is popular in the Northern part of Nigeria, owning to the popularity of its drink. Sobo richly contains anthocyanin pigment, red in colour and is a rich source of vitamins and minerals such as calcium and iron. It is responsible for the red colour of the drink (Onuah et al., 2014).

Studies have shown that the colour of the drink influence consumer preference for the drink and the variety used for the production of sobo drink (Olayemi et al., 2011). Anthocyanins present in soboin addition to their colourful characteristics possess antioxidant properties thus, the antioxidant activities of these anthocyanins may account for some of the beneficial effects derived from consumption of fruits and vegetables high in anthocyanins against cardiovascular and other diseases (Francis, 2000).

Roselle (H. sabdariffa) is compatible with the Nigeria’s regulating body for Foods and Drugs (NAFDAC) requirements for medicinal plants and is one of the plants that have a long history of safe usage and no reported toxicity (Olukemi et al., 2005). Hence the utilization of this plant as a substitute for acid orange in kilish making can be investigated more so no available information of it utilization on meat products as an ingredient or additive.

Materials and Methods

The study was conducted in the Animal Physical Laboratory, Department of Animal science, Faculty of Agriculture, Usmanu, Danfodiyo University, Sokoto, Sokoto state. The state is located between latitude 13\(^\circ\)1’N and longitude 5\(^\circ\)15’E. It shares border with Zamfara state, Kebbi state and Niger Republic. The estimated total population of the state as at 2006 is about 3,696,999 people, most of whom are Hausa/Fulani tribe and practice Islamic religion (NPC, 2006). It has an altitude of about 350m above sea level and annual rainfall of about 645mm (SERC, 2012). The relative humidity ranges from 21-47% during the dry season and 51-79% during the rainy season with the minimum and maximum temperatures of 15°C and 40°C respectively (Singh et al., 2011).

Breeds of cattle found in this area include; SokotoGudali, Bunaji known as white Fuani and Rahaji known as red Bororo. Some foreign breed like Friesian breed are being managed in some farm within the state. The major occupation of the people in the state is farming which mostly involve the cultivation of grains like millet, sorghum, rice and also vegetables such as onion, tomatoes and raising of livestock such as goat, sheep, cattle etc. (IFAD, 2002).

Sokoto state is one of the highest livestock producing state in the country with an estimated livestock population of 8 million. According to MOA (2005), the state has an estimated number of 3,457,993 million cattle, 2,531,336 million sheep, 4,273,721 million goats, 6,177,030 million poultry, 85, 307 horses, 8,134 donkeys and 70,299 camels. Beef consumption in Sokoto is higher (52%) than the national average (50%) (Yakubuet al., 2013). Kilishi widely consumed in Sokoto, this can be clearly seen from its retail outlets popularly known as suya spotsall over the metropolis and the state at large.

Study Materials

This was classified into meat materials and non-meat materials. The meat material include meat from beef while the non-meat materials include: Acid orange (jawo), natural colour product (sobo), knives, spectrophotometer, measuring cylinder, weighing scales, plastic bottle, mortar and pestle, masking tape for labelling plastic bottle, pen and paper, 0.5mm sieve, spatula, groundnut oil, seasoning, clean water,
groundnut paste/meal, salt, onions and spices (clove, ginger, garlic, hot and red pepper)

Study Plan

The study was conducted in three phases. Phase I was a field study that determined the modal concentration of Acid orange used in kilishi production in Sokoto metropolis. Phase II was a laboratory test to determine the concentration of sobo that is equivalent to that of Acid orange obtained in phase I while phase III was a sensory evaluation and colour preference test to compare samples of kilishi coloured with Acid orange with that coloured with sobo (Table 1).

Table 1: Study plan

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Field survey/laboratory test</td>
<td>To determine the modal concentration of Acid orange used in colouring kilishi.</td>
</tr>
<tr>
<td>2.</td>
<td>Laboratory test</td>
<td>To determine the concentration of sobo that is equivalent to the modal concentration used by kilishi manufacturers, for further production of kilishi with sobo.</td>
</tr>
<tr>
<td>3.</td>
<td>Same or different test (sensory evaluation)</td>
<td>To determine whether kilishi made with Acid orange and kilishi made with sobo are the same in terms of taste. Conducted to see which sample between kilishi made with Acid orange and that made with sobo was more acceptable when visually accessed by consumers.</td>
</tr>
</tbody>
</table>

Phase 1: Determination of Acid orange used in Sokoto metropolis

The phase was to find out the average concentration of jawa used in processing kilishi within Sokoto metropolis, which was used as reference concentration for use in the second phase of the study. Purposive sampling was used to select the five biggest kilishi producers and convenience sampling was used to select an additional 25, making a total of 30 producers who were interviewed. The manufacturers were interviewed on the quantity of Acid orange used per unit volume of slurry in making kilishi. From the information obtained, the quantity of Acid orange used was expressed as Tin per beef quarter. The weight of the Acid orange was estimated by measuring it directly from the regular tin used by most of the manufacturers. The various concentrations of dye used per volume of litre (g/l), and which was afterwards converted to concentration of dye used per Mililitres (Mg/ml), is shown in Appendix II.

Phase II: Determination of concentration of sobo

Samples of kilishi were collected from the manufacturers interviewed in Phase I of the study. The samples were ground and mixed together. Afterwards, a known measurement of the ground sample were diluted in water and then the absorbance taken using a spectrophotometer and this was used as the reference. Different concentrations of sobo were measured for absorbance at 550nm and the concentration that matched the absorbance of the reference was used in colouring the test kilishis sample used in Phase III.

Phase III: Sensory evaluation

In this phase of the study, two kilishi samples were made; A reference sample coloured with 1.12mg/ml of slurry (the modal concentration of Acid orange) and a test sample coloured with 56mg/ml of sobo. Two sessions of sensory evaluation were conducted. The first was a same and different test to determine whether the test sample tastes similar to the reference sample. The second session was a ranking for preference test to compare the reference and test samples for colour preference. Methods outlined by Kemp et al (2009) were followed for the two tests.
The same or different test utilized 10 member; trained, non-smokers panel while the ranking for preference test employed a 50 member consumer panel. In all sessions, the samples were blind-coded, both samples were colour blinded using a red bulb lightened in a dark room and the order of presentation was balanced. Water was provided for palate clensing.

**Data Analyses**

Mode was used to find the concentration of Acid orange inclusion within Sokoto metropolis. Binomial test was used to compare the two kilishi samples for colour preference and to analyze the sensory data.

**Results and Discussion**

The results obtained shows the consumer preferences (Table 2) and sensory evaluation (Table 3) of kilishi made with acid orange in comparison with kilishi made with sobo both as colour ingredients.

**Colour preference**

The result in Table 1 indicated that colour preference between the kilishi made with acid orange and that made with sobo yielded a significant difference at 1% significant level (P<0.01). More than half of the panelists (78%) preferred kilishi made with acid orangeto that made with sobo (22%). This is probably because the colour of kilishi made with acid orange is captivating when compared with the kilishi made with sobo, this may be as a result of the nature of the combination of the coloring agent with other kilishi production ingredients.

A similar study was reported by Dashu *et al.* (2017) where groundnut cake and pepper are partially responsible for the reddish brown colour observed in Kilishi, while in another study Ogunsola and Omojola, (2008) reported the influence of sundry process as attributed to colour change in Kilishi most especially when plant ingredients and spices are used in the infusion slurry, giving it a final dull (brownish) colour. Appearance of the product (colour, appearance, smell) and its state of chewing (crispness, hardness) are the criteria for assessing the quality of Kilishi by consumers (Sabo *et al.*, 2018). Jawa gave kilishi its reddish colour therefore called kilishi. Optical characteristics of product may change with formulation or ingredient line and these results point out the need for close scrutiny of quality control variables (Clydesdale *et al.*, 1979).

**Table 2: Colour Preferences for kilishi**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N</th>
<th>Observed frequency</th>
<th>Asymptomatic significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid orange</td>
<td>39</td>
<td>0.78^a</td>
<td>0.000</td>
</tr>
<tr>
<td>Roselle (Sobo)</td>
<td>11</td>
<td>0.22^b</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

^a^b= frequency bearing different superscript along the same colour differ (P<0.05)

**The Discriminatory Test (Taste)**

The result from the binomial test indicated that there was significant difference in both discriminatory test for taste and colour preference test (P<0.05) between the two samples. This implied that kilishi samples coloured with Acid orange was prefered to that of sobo. Similarly, the two samples tasted different.
Table 3: Binomial distribution for the Discriminatory test

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N</th>
<th>Observed frequency</th>
<th>Asymptomatic significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid orange</td>
<td>9</td>
<td>1.00(^a)</td>
<td>0.002</td>
</tr>
<tr>
<td>Roselle (Sobo)</td>
<td>0</td>
<td>0.00(^b)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

\(^{ab}\) frequency bearing different superscript along the same colour differ (P<0.05)

The result in Table 3 shows that Kilishi coloured with Acid orange was significantly different (P<0.05) from that coloured with sobo in terms of taste. All (100%) the member consumer panel agreed that there was difference in the taste of both the control and the treated samples. By implication, when referring to taste of the two products, kilishi coloured with sobo was not accepted as a substitute for colouring kilishi. Ogunsola and Omojola (2008) reported that several spices used in kilishi production are responsible greatly to the taste of the product.

Conclusion
From the study it is revealed that Roselle (Sobo) is not preferred to acid orange in Kilishi taste. Also acid orange colour is most preferred than Roselle (Sabo) in kilishi.

Recommendations
Based on the findings of this study, It is recommend that; Consumers’ priority should majorly be based on the effect of what they consume health wise. Other natural coloring ingredients should be investigated for substitution of acid orange in kilishi production.

REFERENCES


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