Annals. Food Science and Technology
2016

EFFECT OF CHEMICAL HURDLES ON SENSORY ATTRIBUTES OF *KILISHI*

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Abstract
Kilishi is traditional meat product commonly produced and consumed in West African countries. It is consumption is gradually getting popularity in other parts of the World. Kilishi is known to have good keeping quality because of it is lower moisture content which achieved through sun drying. Production of Kilishi involve careful slicing of meat (usually beef) into a thin layers, sun drying of the sliced meat, infusion of the dried slice into condiment, sun drying of the infused slice, and finally mild roasting over glowing charcoal. The research work studied combined effects of sucrose, citric acid and sodium benzoate on organoleptic acceptability of Kilishi. Sucrose was used at 0, 2 and 4%, citric acid and sodium benzoate were used at 0, 0.1 and 0.2%. Different combination (3×3×3 factorial design) of these hurdles was adopted to obtained total of 27 samples. The hurdles were used as part of the condiment which was produced using defatted groundnut powder, spices, seasoning and salt. Twenty judges aged between 20 and 50 years were asked to evaluate the appearance, taste, aroma, texture and overall acceptability of the products using 7-point hedonic scale. Highest sensory scores were recorded in sample 014, 017 and 023. Significant difference (P≤0.05) was recoded between these samples and the remaining treatment samples in all the tested attributes, but no significant difference (P≤0.05) was recorded between these samples and the control sample (001). Combination of these hurdles was found to improve sensory attribute of Kilishi, hence, the use of these hurdles at stated concentration is recommended.

Key words: Meat, *Kilishi*, Sensory, Sucrose, citric acid, sodium benzoate

Submitted: 05.09.2016 Reviewed: 21.10.2016 Accepted: 25.11.2016

Introduction

Kilishi is a sun-dried traditional African meat product whose origin is lost in antiquity, but there is a dearth of scientific information regarding its physical, chemical and nutritional attributes and method of processing (Igene *et al.*, 1990). *Kilishi* is traditionally prepared from beef infused with spices and defatted groundnut paste and it has a suitable concentration of dissolved solids that binds the moisture in it sufficiently to inhibit the growth of spoilage organism (Iheagwara and Okonkwo, 2016a). It is a ready-to-eat convenience meat product possessing excellent shelf stability at room temperature, making handling and marketing of the product convenient for consumers and retailers (Igene *et al.*, 1990). *Kilishi* is a rich nourishing snack and a source of supplementary animal protein formulated using hurdle technology (Iheagwara and Okonkwo, 2016a). It consist of 46.3% beef and 53.4% non-meat ingredients (Igene *et al.*, 1990).

The sensory quality of the processed product has an economic importance as it might influence the amount of sold product, especially how often a consumer buys the same product (Aaslyng, 2009). Sensory studies are frequently used to evaluate the quality of meat and meat products. Consumers have certain expectations regarding the quality of the meat they purchase (King *et. al.*, 2009). For steaks, chops or roasts, three sensory attributes are of major importance for the hedonic value of the meat: Tenderness, juiciness, and flavour. However, these three parameters can only be assessed on cooked meat. When buying meat, we have to guess the eating quality from the appearance (Aaslyng, 2009). Preferences for meat seem to be strongly affected by colour/appearance and texture and to a lesser extent by changes in flavour. Texture may be understood with juiciness and tenderness as different dimensions of textural quality. Flavour may be regarded as consisting of taste and smell. However, eating or sensory quality

is only one dimension of consumer perceived quality (Becker, 2002). Meat flavour is thermally derived, since uncooked meat has little or no aroma, and only a blood-like taste. During cooking, a complex series of thermally induced reactions occur between non-volatile components of lean and fatty tissues, resulting in a large number of reaction products. The volatile compounds formed in these reactions are largely responsible for the characteristic flavours of cooked meat (Elmore and Mottram, 2009).

The concept of hurdle technology was first introduced by Lothar Leistner in 1978. More recently out of the comprehension of the hurdle technology new concepts for food safety have emerged (Leistner, 1997). Hudles ensures microbial safety in food and maintained its nutritional and organoleptic parameters for consumer preference (Subha, 2013). Food preserved by combined methods (hurdles) remains stable and safe even without refrigeration, and is high in sensory and nutritive value due to the gentle process applied (FOA, 2006). Hurdle application of different treatments offers synergistic advantage compared to separate application of the individual treatments (Bazhal *et al.*, 2003).

Methodology

Sensory analysis was carried out using procedure described by Linda *et al* (1991). Seven Point Hedonic Scale where 1=dislike much and 7=like much was use in scoring. The organoleptic properties evaluated were appearance, taste, aroma, texture and overall acceptability. Sensory panel consisted of 20 panelists cutting across staff and students (aged between 20 and 50 years) drawn from Department of Food Science and Technology was used in the research.

The data generated were subjected to analysis of variance (ANOVA) at 5% level of significance using Statistical Package for Social Science (SPSS 16.0 for windows). Means were separated using Duncan's multiple range test.

Procurement of raw material for *Kilishi* production

Beef was purchased from Kano central abattoir. Ginger, Cloves, Black Pepper, Hot Pepper, Sweet Pepper, onion, curry, salt, seasoning and peanut cake were purchased from *Kurmi* Market in Kano. Sucrose, food grades of citric acid and sodium benzoate were purchased from Singer market in Kano.

Production of *Kilishi*

Kilishi was produced using procedure described by Okonkwo *et al.* (2013) and recipe recommended by Badau *et al.* (1997) was adopted for condiments formulation.

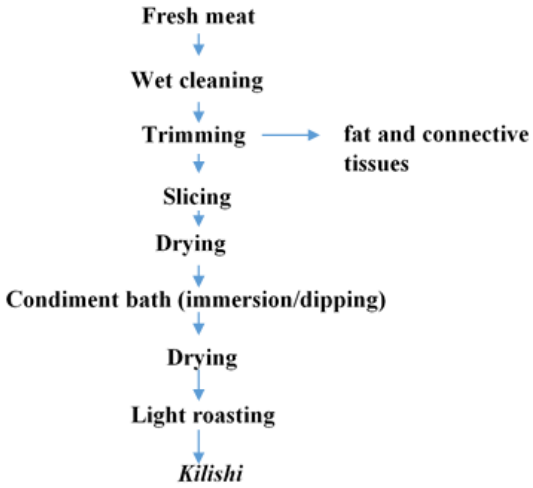

Figure 1: Tradition *Kilishi* Production Process
Source: Okonkwo *et al.* (2013)

The table below 2 provides recipe for the production of *Kilishi* condiment.

Table 1: Recipe for Production of *Kilishi* Condiment

Ingredients	Quantity (g)
Ginger	17.9
Cloves	1.3
Black Pepper	2.5
Hot Pepper	5.3
Sweet Pepper	11.0
Onion	12.5
Curry	3.7
Salt	23
Seasoning (Maggi)	53.5
Peanut cake	469.3

Source: Badau *et al.* (1997).

TABLE 2. Percentages of Hurdles and Condiment used in *Kilishi*

Sample code	Sucrose	Citric acid	Sodium benzoate	Condiment	Meat
001	0.0	0.0	0.0	45.0	55
002	0.0	0.0	0.1	44.9	55
003	0.0	0.0	0.2	44.8	55
004	0.0	0.1	0.0	44.9	55
005	0.0	0.1	0.1	44.8	55
006	0.0	0.1	0.2	44.7	55
007	0.0	0.2	0.0	44.8	55
008	0.0	0.2	0.1	44.7	55
009	0.0	0.2	0.2	44.6	55
010	2.0	0.0	0.0	43.0	55
011	2.0	0.0	0.1	42.9	55
012	2.0	0.0	0.2	42.8	55
013	2.0	0.1	0.0	42.9	55
014	2.0	0.1	0.1	42.8	55
015	2.0	0.1	0.2	42.7	55
016	2.0	0.2	0.0	42.8	55
017	2.0	0.2	0.1	42.7	55
018	2.0	0.2	0.2	42.6	55
019	4.0	0.0	0.0	41.0	55
020	4.0	0.0	0.1	40.9	55
021	4.0	0.0	0.2	40.8	55
022	4.0	0.1	0.0	40.9	55
023	4.0	0.1	0.1	40.8	55
024	4.0	0.1	0.2	40.7	55
025	4.0	0.2	0.0	40.8	55
026	4.0	0.2	0.1	40.7	55
027	4.0	0.2	0.2	40.6	55

Results and Discussion

The mean scores for the sensory attributes presented in Table 3 and Figure 2 below.

Highest sensory scores (Fig 2) were recorded in sample 014 (2% sucrose, 0.1 %CA, 0.1% SB), sample 017 (2% sucrose, 0.2%CA, 0.1%SB) and sample 023 (4% sucrose, 0.1%CA, 0.1%SB). Significant difference ($P \leq 0.05$) was observed between these samples and the remaining samples in all the tested sensory parameters. These treatments were considered to have the best sensory attributes among all the treatments and also considered to be most acceptable among others.

Elmore and Mottram (2009) reported that meat flavour is thermally derived, when meat is cooked. Flavour develops as a result of Maillard reaction, between amino acids and reducing sugars, this is responsible for typical meaty flavour. Gerhard (2006) also reported that Sugars are used in meat products because of their contribution to flavour, their role in browning during the frying process and also their ability to disguise high levels of salt in a meat products. The water-soluble compounds in meat not only act as flavour precursors but also possess taste properties. Elmore and Mottram (2009) reported that in beef, sugars may contribute to sweetness, while organic acids provide sour taste.

Different response were recorded during sensory evaluation of these samples, this contradict the finding of Odigbo *et. al.* (2011) who opined that roasting of *Kilishi* results in masking flavour that result in single and distinct flavour. Direct sun-drying which was adopted in this research was reported to effect organoleptic properties of *Kilishi* (Apata *et al.*, 2013). Leistner (1994) reported that intelligent combination of hurdles secures the microbial stability and safety as well as the sensory, nutritive, and economic properties of a food. Jae *et al.* (2006) reported that addition of vinegar and sake lowered the hedonic scores of packaged seasoned beef.

Iheagwara and Okonkwo (2016a) reported that varying the percentage of ingredients used in the infusion slurry for the *kilishi* production significantly affects the physicochemical and organoleptic characteristics of the *kilishi* product. Similar finding was also reported by Jega *et al.* (2013) in fish *Kilishi*. Olusola *et al,* (2012) opined that variation in condiment formulation does not affect colour of *Kilishi* but meat type can significantly affect all the sensory attributes of *Kilishi.* Iheagwara and Okonkwo (2016b) reported that spices used in the *kilishi* production affected the consumer preference. Igene *et al.* (1990) and Badau *et al.* (1997) reported that *Kilishi* produced in laboratory was organoleptically superior to a commercial *Kilishi* and was remarkably stable.

These treatments were considered to have best sensory attributes among other treatments and also considered to be most acceptable. Significant difference ($P \leq 0.05$) was recoded between these samples and the remaining treatment samples in all the tested attributes,

but no significant difference (P≤0.05) was not recorded between these samples and the control sample (001). Combination of these hurdles was found to improve sensory attribute of *Kilishi*, hence, the use of these hurdles at stated concentration is recommended *Kilishi*.

Table 3. Effect of chemical hurdles on acceptability of *Kilishi*

Sample Code	Sensory Attributes				
	Appearance	**Taste**	**Aroma**	**Texture**	**Overall Acceptability**
001	6.05±0.89^{a}	6.20±0.79^{ab}	6.15±0.67^{a}	5.55±0.76^{a}	6.15±0.67^{ab}
002	5.20±1.51^{bc}	5.30±1.13^{c}	5.40±1.05^{b}	5.20±1.36^{ab}	5.75±1.25^{b}
003	4.80±1.70^{cd}	4.30±1.78^{ef}	4.60±1.23^{c}	3.90±1.41^{d}	4.50±1.67^{e}
004	5.50±1.69^{b}	5.80±0.62^{b}	5.30±0.92^{b}	5.40±1.23^{ab}	5.80±0.62^{b}
005	4.60±0.82^{cd}	4.60±1.47^{e}	4.70±1.38^{c}	4.50±2.01^{c}	5.20±0.89^{c}
006	5.10±1.48^{c}	4.10±1.62^{f}	4.00±1.89^{d}	4.20±2.38^{cd}	4.60±1.47^{de}
007	5.30±1.46^{bc}	4.60±2.01^{e}	4.20±1.64^{d}	4.10±2.20^{d}	4.90±1.68^{d}
008	4.10±1.48^{d}	4.40±1.90^{ef}	4.40±1.67^{cd}	5.00±1.78^{b}	5.00±1.59^{cd}
009	4.90±1.41^{c}	4.70±1.53^{e}	4.80±1.51^{c}	4.70±1.78^{bc}	5.00±1.21^{cd}
010	4.70±1.38^{cd}	4.40±1.90^{ef}	4.90±1.74^{bc}	4.90±1.68^{b}	4.80±1.77^{d}
011	5.80±0.89^{ab}	4.20±1.82^{f}	4.70±1.66^{c}	5.00±1.72^{b}	5.30±1.03^{c}
012	5.00±1.38^{c}	4.90±1.07^{d}	5.00±1.03^{bc}	4.70±0.92^{bc}	5.20±0.77^{c}
013	5.50±1.40^{b}	5.20±1.70^{cd}	4.70±1.46^{c}	4.90±1.33^{b}	5.10±1.62^{c}
014	6.10±0.91^{a}	6.55±0.51^{a}	6.60±0.50^{a}	5.65±0.93^{a}	6.65±0.49^{a}
015	5.20±1.20^{bc}	5.40±1.54^{c}	4.50±1.32^{cd}	4.10±1.55^{d}	5.30±1.13^{c}
016	4.70±1.30^{cd}	4.60±2.06^{e}	4.50±1.61^{cd}	4.40±2.16^{c}	4.80±1.70^{d}
017	5.90±0.72^{ab}	6.40±0.82^{a}	6.40±0.60^{a}	5.58±0.75^{a}	6.65±0.59^{a}
018	5.20±1.82^{bc}	4.20±2.29^{f}	4.80±1.36^{c}	4.30±.90^{cd}	5.00±1.78^{cd}
019	4.30±1.30^{d}	4.20±1.94^{f}	4.90±1.86^{bc}	4.40±2.16^{c}	4.80±1.58^{d}
020	4.70±1.22^{cd}	4.70±1.59^{e}	4.50±1.47^{cd}	4.70±1.84^{bc}	5.20±1.26^{c}
021	4.80±1.51^{cd}	3.90±2.49^{g}	4.40±1.67^{cd}	4.30±1.84^{cd}	4.70±2.06^{de}
022	4.20±1.58^{d}	5.00±0.46^{d}	4.80±1.44^{c}	4.90±1.55^{b}	5.20±1.51^{c}
023	5.58±0.59^{ab}	6.60±0.81^{a}	6.35±0.59^{a}	5.85±1.04^{a}	6.50±0.51^{a}
024	4.10±1.68^{d}	4.00±1.21^{fg}	4.40±1.05^{cd}	4.60±1.47^{c}	4.80±1.28^{d}
025	3.60±1.60^{e}	4.70±0.92^{e}	4.60±0.68^{c}	5.10±0.97^{b}	5.10±0.97^{c}
026	5.20±1.99^{bc}	4.70±1.72^{e}	4.60±2.01^{c}	4.00±2.20^{d}	4.90±1.25^{d}
027	4.90±1.25^{c}	4.80±1.88^{de}	4.40±1.39^{cd}	5.00±0.92^{b}	5.10±1.55^{c}

NOTE: *All values are Mean±Standard deviation.
*Different letters in the same column indicate significant difference among samples (P≤0.05)

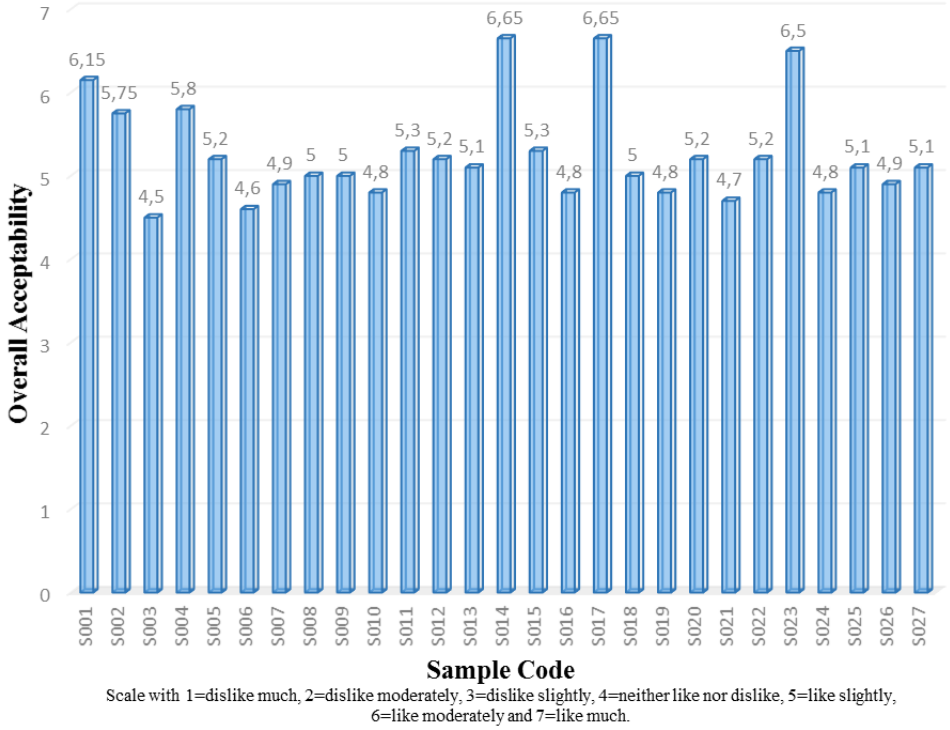

Figure 2: Acceptability of *Kilishi* samples treated with different hurdle combinations.

Conclusion

The study revealed that combination of sucrose, citric acid and sodium benzoate is effective in improving organoleptic acceptability of *Kilishi*. Higher sensory scores were recorded in sample 014 (2% sucrose, 0.1 %CA, 0.1% SB), sample 017 (2% sucrose, 0.2%CA, 0.1%SB) and sample 023 (4% sucrose, 0.1%CA, 0.1%SB). These treatments were considered to have best sensory attributes among other treatments and also considered to be most acceptable. Significant difference ($P \leq 0.05$) was recoded between these samples and the remaining treatment samples in all the tested attributes, but no significant difference ($P \leq 0.05$) was not recorded between these samples and the control sample (001). Combination of these hurdles was found to improve sensory attribute of *Kilishi*, hence, the use of these hurdles at stated concentration is recommended *Kilishi*.

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