PROXIMATE COMPOSITION, PHYTOCHEMICAL ANALYSIS AND HEALTH-PROMOTING BENEFITS OF SOME COMMONLY CONSUMED INDIGENOUS MEAT SPICES IN NIGERIA

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Abstract
This study evaluated the proximate composition, phytochemical analysis and health-promoting benefits of five commonly consumed indigenous meat spices in Nigeria. The spices are ginger rhizome (Zingiber officinale), garlic bulb (Allium sativum), onion bulb (Allium cepa), curry leaf (Murraya koenigii) and thyme leaf (Thymus vulgaris). The result showed that the spices on dry weight basis contained moisture ranging from 4.34% in thyme to 9.78% in onion; ash content ranged from 2.40% (onion) to 12.2% (curry). The crude protein content ranged from 6.34% in garlic to 11.58% in curry, while crude fat was from 0.83% (garlic) to 15.06% in onion. The fibre content of the spices also ranged from 2.10% in garlic to 15.48% in thyme. Total carbohydrate (nitrogen free extract) ranged from 39.37% in curry to 76.61% in onion. These spices are sources of nutrients with higher percentage of carbohydrates. The phytochemical screening of spices revealed the presence of bioactive constituents comprising flavonoid, alkaloid, saponin and tannin observed in different plant parts. In addition, these indigenous meat spices also have health-promoting benefits and not only flavouring attributes. Therefore, indigenous spices should be used as dietary component especially when cooking meat, and not only as mere food adjuncts.

Keywords: Proximate, Phytochemical, Health benefits, Indigenous meat spices, Nigeria

Received: 24.09.2019 Reviewed: 25.02.2020 Accepted: 28.02.2020

1. INTRODUCTION

The demand for meat is increasing as a result of rapid human population and change in life style (Sofi *et al*., 2010). Meat is the edible tissues of animals that are safe and acceptable for human consumption. All processed and manufactured products which might be prepared from these tissues are also regarded as meat (Aberle *et al*., 2012). Meat is an excellent source of high quality protein, essential amino acids and minerals. However, value addition is essential so as to improve meat flavour, overall acceptability and prolong its shelf-life (Eyas Ahmed *et al*., 2006). Health conscious consumers are wary of potential dangers of consuming chemically synthetic products as a result of speculations that manufactured seasonings are directly or indirectly responsible for the prevalence of some diseases. There is therefore the need for utilization of effective and natural alternatives such as herbs and spices to enhance the flavour, extend shelf-life, increase overall quality of foods as well as improve health of consumers (Tajkarimi *et al*., 2010). Spices are plants or plant materials from indigenous or exotic origin commonly used in most dishes as flavour, colour enhancer and natural preservatives in meats, foods and beverages (Pundir & Sharma, 2010; Teye *et al*., 2013). Spices can be obtained from the bark (cinnamon), root (ginger, onion, and garlic), buds (cloves), seeds (mustard, sesame), berry (black pepper), or the fruit (allspice) of tropical plants and trees. They are either used as whole, ground in processed state or in form of extracts (oils and oleoresins). The utilization of spices in various forms has been well documented as it inhibits growth of spoilage bacteria and fungi in meats (Subbulakshmi & Naik, 2002; Rajkumar & Berwal, 2003). Spices and condiments are also used as preservatives, appetizers and to garnishing foods, meat and meat products as well as to prevent

decomposition by microbial growth or undesirable chemical changes (Gyesley, 2008; Fredrick *et al*., 2012). Although spices are used in small quantities in the processing of meat and meat products, however, they are indispensable because of its unique contribution to colour, flavour, and stability of product. In culinary concerns, spices give piquancy to tasteless food served in homes, cafés and restaurants. It is worthy to note that spices are not only used as flavorings and seasonings, but are also used in perfumery, cosmetics, and toiletries.

Dietary phytochemicals are found in wide range in fruits, vegetables, legumes, whole grains, nuts, seeds, fungi, herbs and spices (Mathai, 2000). They are known as secondary metabolites or phytochemicals and comprise flavonoids, alkaloids, saponin, tannins, phenolics, steroids, glycoside, and terpenes (Ujuwundu *et al*., 2010). Spices and other biogenic additives (herbs, plant extracts and essential oils) have been used for all over the world for centuries not only as food preservatives and appetizers, but also in the treatment of certain ailments as well as in traditional medicine (Zhang *et al*., 2009). The increasing interest in exploiting the properties of spices for medicinal purposes reveals the importance of natural sources of biologically active substances (Hobbs, 2000). They have considerable health-promoting benefits based on the content of antioxidants, phenolic compounds, tocopherol, carotenoids and antibacterial compounds (Zhang & Wang, 2002; Zhou *et al*., 2010). Studies have shown that the prevention of cardiovascular diseases and cancer is associated with the ingestion of spices, fresh fruits, vegetables rich in natural antioxidants (Virgili *et al*., 2001). Nutritionally, spices are rich in protein, vitamins and minerals, fibre, but low in fat content (Chirinang & Intarapichet, 2009).

Some commonly consumed indigenous spices in Nigeria include black pepper, alligator pepper, garlic, ginger, clove, onion, curry and thyme and basil. Ginger (*Zingiber officinale*) is a major aromatic herb grown in Nigeria as a rhizome with sweet, strongly aromatic and sharp pungent flavour. Ginger is well known all over the world especially for its use in the treatment of gastrointestinal tract disorder such as constipation, dyspepsia and nausea. It was reported that ginger has medicinal properties against digestive disorders, rheumatism and diabetes (Afzal *et al*., 2001). The consumption of ginger in led to reduction in blood cholesterol and also served as a potential anti-inflammatory and antithrombotic agent (Thomson *et al*., 2002).

Garlic (*Allium sativum*) has a characteristic pungent, spicy flavour that mellows and sweetens considerably with cooking with various meat types (Tang & Cronin, 2007). It is well known as a seasoning for food flavoring and as a therapeutic agent for the prevention and treatment of an array of diseases due to its antibacterial, fungicidal, virucidal, antioxidant, anti-inflammatory, antiseptic, anti-ageing and heavy metal detoxifier effects (NCCIH, 2016).

Onions (*Allium cepa*) are consumed raw or cooked either as young green plants or as bulbs. It can also be used in fresh or dried form. They are valued for their distinctive pungency and flavour which improve the taste of foods such as comminuted meats, sauces, soups, salad dressings and pickle relishes (Kumar *et al*., 2006).

Curry (*Murraya koenigii*) is an inevitable part of spicing up dishes used in small quantities for their distinct aroma due to the presence of volatile oil and their ability to improve digestion. It is also used for the prevention of diabetes due to pharmacological properties owing to its essential oil as it reduces blood glucose level (Amin *et al*., 2011). It contain essential oils, coumarins, terpenoids, carbazole alkaloids, vitamins, α-tocopherol, β-carotene, and lutein (Choudhury & Garg, 2007), with documented antioxidant hypoglycemic, anticarcinogenic and antimicrobial properties (Ningappa *et al*., 2008).

Thyme (*Thymus vulgaris*) is a pleasant smelling perennial herb used traditionally for several culinary and medicinal purposes. It is an expectorant and has antiseptic, antimicrobial

and antioxidant actions; lowers cholesterol levels; and eliminates scalp itching and flaking caused by candidiasis (Lingenfelter, 2011). This study therefore aimed to evaluate the proximate composition, phytochemical analysis and health-promoting benefits of some commonly consumed indigenous meat spices in Nigeria.

2. MATERIALS AND METHODS

The experiment was carried out at the Processing Laboratory of the Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

2.1. Collection of samples

Fresh samples of ginger rhizome (*Zingiber officinale*), garlic bulb (*Allium sativum*), onion bulb (*Allium cepa*), curry leaf (*Murraya koenigii*) and thyme leaf (*Thymus vulgaris*) were sourced from local markets within Abeokuta, Ogun State, Nigeria.

2.2. Processing of samples

The outer skin of ginger rhizome was peeled, while the outer scaly leaves of whole garlic and onion bulbs were also removed. These samples were then cut into smaller pieces and oven-dried at 60^{o}C for 48 hours. Freshly harvested curry and thyme leaves were cleaned with distilled and freeze-dried. Thereafter, dried samples of spices were finely ground to powder separately and stored at 4^{o}C for further analysis.

2.3. Proximate composition and phytochemical analyses

Proximate constituents of dried samples of spices were analyzed for moisture, crude fat, crude protein, and ash in accordance with the official methods of the Association of Official Analytical Chemists (AOAC, 2003). Total carbohydrates were estimated by difference: 100 - (% moisture + % crude protein + % crude fat + % ash content). The phytochemical analysis of spices for flavonoids, alkaloids, saponins and tannins was carried out according to the procedures described by Sofowora (1978), Trease & Evans (1989) & Ayoola *et al*. (2008).

Test for Flavonoid

A portion of the extract was heated with 10ml of ethyl acetate over a steam bath for 3 minutes. The mixture was filtered and 4ml of the filtrate of the extract was shaken with 1ml of dilute ammonia solution. A yellow colouration indicates the presence of flavonoid (Trease & Evans, 1989; Sofowora, 1993; Ayoola *et al*., 2008).

Test for Alkaloid

A 0.5g of the extract was diluted to 10ml with acid alcohol, boiled and filtered. To 5ml of the filtrate was added 2ml of dilute ammonia. 5ml of chloroform was added and shaken gently to extract the alkaloid base. Chloroform layer was extracted with 10ml of acetic acid, and was divided into three portions. Mayer's reagent was added to a portion, Wagner's reagent was also added to another and then, Drangendorff's reagent was added to the last portion (Trease & Evans, 1989; Sofowora, 1993; Ayoola *et al*., 2008).

Test for Saponin

To 0.5g of the extracts were added 5ml of distilled water each in a test-tube. The solution was shaken vigorously and observed for a stable persistent froth for 20 minutes. The frothing was mixed with 3 drops of olive oil and shaken vigorously. The formation of an emulsion indicates the presence of saponin.

Test for Tannin

A known quantity (0.5g) of the extract was boiled in 10ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride were added. A brownish green, dark green or a blue-black colouration indicated the presence of tannin (Trease & Evans, 1989; Sofowora, 1993; Ayoola *et al*., 2008).

3. RESULTS AND DISCUSSION

Table 1 showed the results of proximate composition of samples of indigenous meat spices analyzed.

Table 1: Proximate composition of some commonly consumed indigenous meat spices in Nigeria

	Composition (%)					
Parameter	**Ginger**	**Garlic**	**Onion**	**Curry**	**Thyme**	**SEM**
Moisture	8.70[b]	7.55[c]	9.78[a]	6.84[d]	4.34[e]	0.55
Ash	6.30[c]	5.10[d]	2.40[e]	12.20[a]	11.00[b]	0.09
Crude protein	8.58[c]	6.34[d]	9.45[b]	11.58[a]	9.39[b]	0.04
Crude fat	5.35[b]	0.83[d]	15.60[a]	5.44[b]	4.64[c]	1.31
Crude fibre	3.25[c]	2.10[e]	6.03[b]	2.50[d]	15.48[a]	1.33
Nitrogen free extract	72.76[c]	73.07[b]	76.61[a]	39.37[e]	45.02[d]	4.23

[a, b, c, d, e]: Means on the same row with different superscripts are significantly ($p<0.05$) different
SEM: Standard Error of Mean

The moisture content of samples analyzed ranged from 4.34% in thyme leaf to 9.78% in onion bulb. Onion, *Allium cepa* has high moisture content which underscored its perishability and susceptibility to microbial spoilage; hence the need for proper preservation. However, low moisture content of thyme (*Thymus vulgaris*) indicated its possible long shelf-life. The ash content of curry leaf (12.2%) is similar to the result (13%) obtained by Vandana *et al.* (2011) and this indicated that it a promising source of mineral elements. Ash is an indication of the total inorganic mineral elements contained in any edible substance (Edeogu *et al*., 2007). Ash provides an insight into the nutritionally important inorganic mineral elements contained in foods (Edeogu *et al*., 2007). The result further showed that the protein content of curry (11.58%) is higher than the value (6.39%) reported in the findings of USDA nutrient database (USDA). The protein content in curry leaf can make fair contributions to dietary protein in human diets as it is involved in formation of hormones, enzymes and structural membranes. Garlic is preferred as spice due to its low amount of crude fat (0.83%) which helps to reduce the risk of cardiovascular diseases and aging (Bamishaiye *et al*., 2011). Garlic as a dietary hypolipidemic spice is beneficial in protecting the structural integrity and fluidity of erythrocytes under conditions of hypercholesterolemia and hypertriglyceridemia (Kempaiah & Srinivasan 2002, 2004). Thyme (*Thymus vulgaris*) contained high percentage of dietary fibre (15.48%). Dietary fibre lowers cholesterol level, risk of coronary heart disease, diabetes and cancer (Ishida *et al*., 2000). Crude fiber in diets stimulates the contraction of muscular walls of the digestive tract, thus counteracting constipation and elimination of wastes (Ponnusamy & Vellaichamy, 2012). The spice samples were found to be good sources of carbohydrates. Onion had the highest concentration of nitrogen free extract (76.61%) as compared to thyme which had the lowest concentration (45.02%).

The result of phytochemical analysis, name (botanical, common and indigenous- in Yorùbá language), plant part used and identification of some commonly consumed indigenous meat spices in Nigeria is shown in Table 2. From the result, phytochemical screening indicated the presence of flavonoid, alkaloid, saponin and tannin. These phytochemicals play a vital role in the medicinal properties such as anti-diabetic, antioxidant, antimicrobial, anti-inflammatory, anticarcinogenic and hepato-protective properties (Kirupa & Kariitha, 2015). These spices are rich sources of pharmacological compounds (polyphenolics) having strong antioxidant properties and could potentially replace the synthetic antioxidants in foods, and thus enhance health benefits when consumed (Rahman, 2010). The plant parts used are the rhizome, bulb and leaves. However, it is worthy to note that the chemical composition of these herbs and spices may vary distinctly due to climatic conditions, soil, species, time of harvest and degree of maturation and parts used (Wald, 2003).

Spices have not only flavoring attributes but they also have considerable health-promoting benefits as presented in Table 3.

Table 2: Phytochemical analysis of some commonly consumed indigenous meat spices in Nigeria

		Phytochemical				
Name of spice	**Plant part used**	**F**	**A**	**S**	**T**	**Image**
Botanical- *Zingiber officinale* Common- Ginger Indigenous- Ata ilẹ̀	Rhizhome	+	+	+	-	
Botanical- *Allium sativum* Common- Garlic Indigenous- Ááyù	Bulb	+	+	+	+	
Botanical- *Allium cepa* Common- Onion Indigenous- Àlùbósà	Bulb	+	+	+	+	
Botanical- *Murraya koenigii* Common- Curry Indigenous- Efirin ọ̀sọ́	Leaf	+	+	+	+	
Botanical- *Thymus vulgaris* Common- Thyme	Leaf	+	+	+	+	

F = Flavonoid, A = Alkaloid, S = Saponin, T = Tannin
+ = Present, - = Absent

Table 3: Health-promoting benefits of some commonly consumed indigenous meat spices in Nigeria

Spices	**Health-promoting benefits**	**References**
Ginger	Digestive stimulant Antimicrobial	Afzal *et al*. (2001), Platel & Srinivasan, 2004
Garlic	Protection of erythrocyte integrity in hypercholesterolemic condition Antidiabetic Antibacterial, antifungal, antiviral, anticancer, antioxidant, anti-inflammatory, anti-ageing and heavy metal detoxifier effects	Sovova and Sova (2004) Chowdhury *et al.* (2002) Shalaby *et al.* (2006), Fleischauer & Arab, 2001, Durak *et al.* (2002), Bhandari *et al*. (2005)
Onion	Antidiabetic Antibacterial and antifungal	Shalaby *et al.* (2006), Durak *et al.* (2002)
Curry	Antioxidant hypoglycemic, anticarcinogenic and antimicrobial	Chandarana *et al*. (2005)
Thyme	Digestive stimulant Antiseptic, antimicrobial and antioxidant actions	Platel & Srinivasan, 2004

Dietary hypolipidemic spices such as turmeric, garlic, onion and ginger are effective as hypocholesterolemic substances under various conditions of experimentally induced hypercholesterolemia/hyperlipemia (Srinivasan *et al*., 2004). They offer this beneficial effect by correcting altered cholesterol to phosphorus ratio in the erythrocytes in hypercholesterolemic situation thereby restoring antioxidant status of erythrocytes in both hypercholesterolemic and hypertriglyceridemic conditions (Kempaiah & Srinivasan, 2004). These changes would also increase the risk of atherosclerosis and heart diseases. Garlic and onion have been widely used for their antidiabetic potential. These spices are hypoglycemic in different diabetic animal models and human trials as a result of the sulfur containing compounds (di (2-propenyl) disulfide and 2-propenylpropyl disulfide).

Spices are well known to stimulate gastric function; they intensify salivary flow and gastric juice secretion and, hence, aid digestion. Ginger, mint, thyme and garlic are used as digestive stimulants as well as home remedies for digestive disorders like flatulence, indigestion, and intestinal irratation (Ponnusamy & Vellaichamy, 2012; Platel & Srinivasan, 2004). Ginger, onion and red pepper enhanced secretion of bile acids, which are vital for fat digestion and absorption, and stimulation of the activities of pancreatic and intestinal enzymes involved in digestion (Platel & Srinivasan, 2000). Food mutagens are formed under certain cooking and processing conditions. These harmful products can be modified by the presence of antimutagens in foods. Spices that have antioxidant property can function as antimutagens. Considerable attention has been focused on identifying naturally occurring chemopreventive substances capable of inhibiting, retarding, or reversing multistage carcinogenesis. A wide array of phenolic substances, particularly those present in dietary and medicinal plants, have been reported to possess substantial anticarcinogenic and antimutagenic activities. These naturally occurring phenolics possess antioxidative and anti-inflammatory properties, which contribute to their chemopreventive or chemoprotective activity (Surh, 2002). Garlic is a spice widely studied for its chemopreventive potential. Epidemiological studies have shown that higher intake of garlic is associated with reduced risk of cancers (Fleischauer & Arab, 2001). Several mechanisms have been used to evaluate the cancer-preventive effects of garlic and its organosulfur compounds (Sengupta *et al*., 2004). Other mechanisms include inhibition of mutagenesis, modulation of enzyme activities that suppress bio-activation of carcinogen molecules, inhibition of carcinogen-DNA adduct formation, free radical scavenging, inhibitory effects on cell proliferation and tumor growth.

Lipid peroxidation is a process of vital importance in the food processing industry. During this process, polyunsaturated lipids are oxidized (Khan, 2011) which adversely affects flavour, nutritional value and overall quality of foods. Spices have been shown to have antioxidant properties (Hamzah *et al*., 2014; Harsha *et al*., 2013). Antioxidants are molecules that can neutralize free radicals by accepting or donating an electron to eliminate unpaired condition of electrons thereby protecting the body from damages caused by free radicals (Mondal *et al*., 2013). These free radicals are independent chemicals with one or more unpaired electrons and are responsible for biological injury (Manpreet *et al*., 2004) and contribute to many non-communicable diseases (Gan *et al*., 2013). Polyphenols and other phytochemicals have been shown to have antioxidant properties. It was revealed that the consumption of polyphenol-rich foods is associated with a reduced risk of cardiovascular diseases, stroke and certain types of cancer (Jagadish *et al*., 2009). The consumption of dietary antioxidants helps to prevent free radical oxidative damage by inhibiting the initiation step or interrupting the propagation step of oxidative damage (Olajire & Azeez, 2011). The antimicrobial activity of spices indicated that ginger is active against *B. subtilus*, *S. aureus* and *E. coli* due to phenolic compounds

(Chandarana *et al*., 2005).
The essential oil, alkaloid, curcumins, turmerol and veleric acid are accountable for its antimicrobial activity. Odhav *et al*. (2002) opined that the mechanism of antimicrobial action of spices include hydrogen bonding and hydrophobic interaction of various phenolic compounds with protein membrane, which may in turn cause cell membrane disturbance, disruption of cell wall and damage of electron transport chain. The antimicrobial action of various phenolic complexes was associ- ted with the inactivation of cellular enzymes which relied on the penetration rate into the cell and changes in membrane permeability (Moreno *et al*., 2006). A change in cell membrane permeability is the main factor in antimicrobial action of a particular compound. Phenolic compounds may completely disrupt cellular membranes, affect cellular integrity and cause ultimate cell death. The summary of the beneficial health-promoting effects of the indigenous meat spices is as shown in Figure 1.

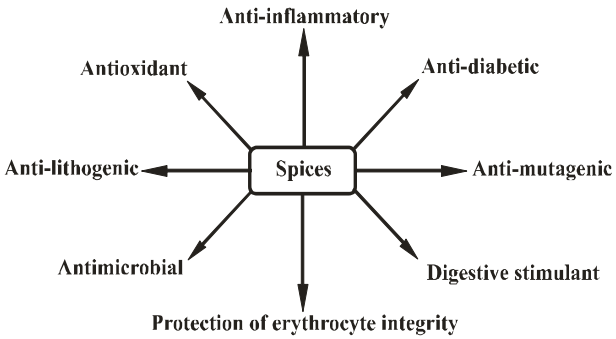

Figure 1: Summary of the health-promoting benefits of some commonly consumed indigenous meat spices

4. CONCLUSION

Spices are essential ingredients used to enhance the colour, flavour and palatability of Nigerian dishes. However, indigenous meat spices in Nigeria (ginger, garlic, onion, curry and thyme) have not only flavoring attributes, bioactive compounds and also serve as sources of nutrients, thereby enhancing considerable health benefits when consumed.

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