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Bioactive Compounds and Medicinal Value of two Spices-*Zingiber officinale Rosc.* and *Curcuma longa* Linn

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Abstract

Zingiber officinale Rosc. and Curcuma longa Linn are two medicinal plants widely used as spices and are known in folk medicine for their various uses. Qualitative and quantitative analyses of the two spices were undertaken in various solvents using different methods to determine the medicinal value of these spices. The spices were assessed for the following phytochemicals: glycosides, flavonoids, saponins, alkaloids, terpenoids, tannins, tannins, phenols, carotenoids, anthocyanins and steroids. The test compounds were present in most of the screened plant extracts. Morever phytochemicals were highly present in ethanol extracts of both plants than in ethyl acetat extracts. Anthocyanins, phenols and tannins were the most common phytochemicals present in the extracts. Quantitative analysis showed that the plants contained various concentrations of phytochemicals. The results also indicated that C.longa contained appreciable amounts (0.02±0.01-15.07±0.04%) of phytoconstituents other than ginger (0.02±0.03-22.41%). The spices contained different bioactive compounds with biological properties leading us to conclude that consumption of the two varieties of capsicum spices may be important in health care and could be recommended in nutritional supplementation either as source of drugs in folk medicine.

Keywords: Spices, Nutrition, Analysis, Phytochemical, Medicinal.

Introduction

Tropical plants in Africa are known for their multiple uses in nutrition as spices, or components of bloods and in folk medicines as drugs to prevent or to cure various diseases. Among them *Zingiber officinale* (Roscoe), Zingiberaceae family, is a perennial plant (herbaceous in form of rhizome) found in warm climatic regions like Nigeria, Bangladesh, Taiwan, India, Jamaica and the United States of America. The rhizome contains numerous active compounds with medicinal properties. These properties contributed to its various medical applications.

Ginger is commonly used as a spice[1,2] and has also been used to treat diarrhea, nausea, asthma and respiratory disorders[3]. In addition ginger extracts are reported to be natural larvicidal agents[4] and showed anti-inflammatory, antioxidant and anti-cancer effects. Shogaol can significantly attenuate a variety of neuro inflammatory responses in cortical astrocytes[5,6].

The chemical constituents of *Z.officinale* are numerous depending on such factors like the origin of the sample and the state of the plant part used (fresh or dry)[7].

Curcuma longa Linn (Zingiberaceae) is a rhizomatous herbaceous perennial herb, cultivated extensively in south and southeast tropical Asia[8], Belgium, France, Ceylon, south India, Indonesia and Bengal[9]. As spice, turmeric is important plant rhizome mainly used in nutrition for its color and aroma[2].

C.longa has been used as a condiment, a healing remedy, textile dye and for regulation of serum cholesterol and lipid peroxide levels[10]. Literature reveals that it was used against inflammations, cholagogue, hepatic, asthma, stomach pains, its antitumor, antiprotozoal, carminative properties and its ability to purify blood and liver regulation[11]. Numerous studies have shown good antioxidant properties of ginger[1,12] and turmeric[13].

Various literature reports were found on the chemistry of the ginger and turmeric rhizomes[7,14-16] but no study was found on the species from Congo. The present investigation was aimed to determine the phytochemical profile of *G.officinale* and *C. Longa* in order to determine the medicinal importance of these spices.

Materials and Methods

Samples of *G.officinale* and *C. longa* were bought from the local 'Total' market in Bacongo, South –Brazzaville in July 2014. Identification and authentification of the plant samples were done by Nkouka Saminou from the national herbarium of the vegetal research centre of Brazzaville (ex-OROSTOM-Congo) where voucher specimens are deposited. The plant samples were dried in an oven at 100-105°C for 24 hours and

milled into a powder. The powder was stored under dry conditions before analysis.

Chemical analysis: Physico-chemical analysis: The extractive values of the samples were determined by using various methods of extraction in water. Physico-chemical analysis was performed on water extracts obtained by infusion, this being the highest yield method. Titratable acidity was determined by titration with a dilute sodium hydroxide solution (0.1M/L). The PH and the temperature values of the solutions were measured automatically with a ph-meter. The results are presented in Table-1.

Qualitative and quantitative phytochemical analysis: Extraction procedure: The powdered samples (15g) from each plant were soaked in 100ml of 98% ethanol solution for 72 hours. After filtration of the obtained solutions, the filtrates were evaporated at room temperature for five days and submitted to phytochemical screening. For *C.longa* the defatted material was used for extraction then 40g of the powder were delipidated twice with 100ml of diethyl ether for 24h.

Preliminary phytochemical screening: Phytochemical analysis was carried out to confirm the presence of the various phytochemicals in the samples. The phytochemical constituents of the spices were determined according to the described methods[17-22].The phytochemicals tested were alkaloids, flavonoids, glycosides, Tannins, triterpeoids, steroids, saponins,phenols, carotenoids and anthocyanins, and the corresponding results are shown in Table-2.

Quantitative phytochemical determination: Quantitative evaluation of bioactive constituents was carried out using the classic methods[23-27]. These active compounds include phenols, saponins, alkaloids, flavonoids, cardiac glycosides, anthocyanins and carotenoids.

Statistical analysis: Data were determined as means±SD of triplicate determination.

Table-1
Physico-chemical characteristics of *Z.offinales* and *C.longa* extracts

Plant extract (in water)	Physico-chemical characteristics			Method of extraction and Yield(%)		
	Acidity(g/l)	PH	T°C	Ma	If	De
Z.officinale	0.45	2.30	28.20	2.00	2.20	1.80
C.longa	2.64	3.75	27.80	1.80	2.60	2.10

Ma=maceration; If=infusion; De=decoction

Table-2
Qualiitayive phytochemical analysis of *Z.officinale and C.longa* extracts

Phytochemical	*Z.officinale*		*C.longa*	
	ethanol	Ethyl acetat	ethanol	Ethyl acetat
Alcaloides	+ + +	+	+	+
Flavonoides	+ + +	+	+	+
Glycosides	+ +	+	+	+
Tannins	+ +	+ + +	+	-
Terpenoids	+ + +	+	+ + +	+
Steroids	+ + +	+	+	+
Saponins	-	+ + +	-	-
Phenols	+	+	+ + +	+ + +
Anthocyanines	+	+	+ + +	+ + +
Carotenoids	-	-	+	+ + +

+++= high concentration ++= moderately present += trace concentration

Table-3
Quantitative phytochemical analysis of *Z.officinale and C.longa*

Phytochemical (%)	**Plant specie**	
	Z.officinale	***C.longa***
Alcaloides	11.28±2.05	7.33±0.18
Flavonoides	15.07±0.04	8.5±0.12
Glycosides	00.00	00.00
Saponins	2.13±0.07	22.41± 1.33
Phenols	0.20±1.96	11.33±0.18
Anthocyanins	0.40±3.92	2.33±0.16
Carotenoids	0.02±0.003	0.02±0.01

Results and Discussion

Physico-chemical analysis of water extracts: The results of water extraction shown in Table-1 indicated that infusion was the best method of extraction for both samples with yields of 2.20% for *Z.officinale* and 2.60% for *C.longa*. These values fell within the range of 2.24-2.726% recorded in acetone[8] .They were higher when compared with those reported for *Z.officinale*(1.50%) [28] in petroleum -ether but lower than the 2.90% in ethanol. A very high extract yield was recorded for turmeric (66.20%) and ginger (57.80%)[14]**.** The high yield observed for turmeric was similarly reported in the range of 2.88-3.14%[8].The extract yield may depend on many factors such as the conditions of extraction, the nature of the solvent and the plant part used. *Z.officinal* extract was more acidic than that of turmeric at the same temperature.

Phytochemical screening of plant rhizomes: The results of phytochemical screening of the samples are summarized in Table-1. Qualitative analysis revealed the plants contained phenols, flavonoids, steroids, cardiac glycosides, alkaloids, terpenoids, and anthocyanins in all solvent extracts investigated but in variable concentrations.

The results also revealed that alkaloids and flavonoids were observed to be highly present (+++) in ethanolic extract of *Z.officinale* while they were present in trace quantities (+) in all other extracts as observed for glycosides which contrarily to the first were moderately present (++) in ethanolic extract. Similarly Shipra[29] reported a high presence of alkaloids in ethanolic extract of *Z.officinale* but flavonoids were moderately present. Alkaloids were not detected in polar solvent extract of *C.longa*[30]. These facts correlated with those observed in the present study.

Tannins showed qualitative variations in both plant extracts screened. They were found to be present either in high (+++) concentrations or in moderate (++) amounts in ethyl acetate and ethanolic extracts of *Z.officinale* respectively. However, in ethanolic extract of *C.longa* they were present in trace quantities (+) and completely absent (-) in ethyl acetate extract of the sample.This fact was also reported for *C.longa*[31] and some selected spices[30].

Terpenoids were found to be present in high concentration (+++) in ethanolic extract of *Z. officinale* and *C.longa* while in ethyl acetate extracts of both plants they were present as trace compound(+). Similar fact was observed in *Z.officinale* extract of this solvent[28] but they were completely absent in *C.longa*[30].

Steroids **s**howed qualitatively the same trend as observed for alkaloids and flavonoids. They were found to be highly present in ethanolic extract of *Z.officinale*, however, in all the other extracts of both plants they were detected in trace quantities. In contrast to the present results they were not detected in polar solvent extracts of *Z.officinale*[29].

Saponins were not present in any of the screened solvent extracts of both plants, except in the ethyl acetate extract of *Z.officinale* in which they were highly present. Similarly, saponins were reported to be absent in polar solvent extract of *C.longa*[31], however they were highly present even in polar solent extract of *Z.officinale*[29].

The *C.longa* extracts of ethanol and ethyl acetate showed the high presence of anthocyanins and phenols , while in *Z.officinale* extracts they were present as trace compounds. They were not found in non-polar solvent extract (petroleum)[28] . This fact was also observed in the case of carotenoids, which were completely absent in both *Z.officinale* extracts. However, they were found in a high concentration in ethyl acetate extract of *C.longa* and as trace compounds in ethanolic extract.

The tested compounds were found to be present in all the tested solvent extracts. It was found that they were more highly present in ethanolic extract of *Z.officinale* when compared to all the others plant extracts. The screened solvent extracts showed variations in phytochemical content. This can be explained by the variability of such factors as solubility in the solvent, polarity, the plant part nature (location, growing period), and interaction with other molecules presents in the samples.

Phytochemical screening indicated that these spices contained the phytonutrients including alkaloids, glycosides, tannins, terpenoids, steroids, phenols carotenoids, saponins, flavonoids and anthocyanins**.**

Quantitative analysis of the plant rhizomes: The results of quantitative analysis of the plants are shown in Table-2 and indicate that alkaloids and flavonoids were the most abundant compounds, followed by saponins and phenols.

G.officinale contained the highest alkaloid and flavonoid contents of 11.28±2.05% and 15.07±0.04%) while *C.longa* had the lowest of 07.33±0.18 and 08.50±0.12% for both compounds respectively).

The high alkaloid content reporded in *Z.officinale* (11.21%)[15] was in line with the value recorded for the plants studied. These concentrations were found to be higher when compared with those recorded in other spices like garlic (2.54%)[15] and capsicum species(1.8 and 5.3)(unpublished data).

Alkaloids are found in the leaves, and also in the seeds in little amounts and consequently in rhizomes[32]. This is in contrast with the result of the present work. An increased of alkaloid content was considered as depending of such factors like the favorable environmental conditions and nutrient supply[33].

For instance alkaloids stimulate the nervous systems and play role in blood pressure regulation. Alkaloids are pain relievers, tranquilizers and have also antimicrobial properties[34].

The flavonoid percent of ginger remained higher than the reported 5.56% [15].The same trend was observed when comparing the flavonoid content of *C.longa* with those of others spices such as pepper and garlic (6.38 & 1.16%). However this flavonoid amount was lower than that for *C.longa* which showed a high level of these compounds[7]. The flavonoids concentrations in plants can be influenced by factors such as genotype (species and variety) environment and harvesting period[35]. The high phytochemical contents of the plants recorded in this work justified the multiples utilities and applications of these spices reported in folk medicine due to the claimed properties of alkaloids and flavonoids.

As observed for ginger[15], the result also showed a low saponin content (02.13±0.07%). In contrast to alkaloids and flavonoids which were found in lower amounts in *C.longa*, saponins (22.41±1.33%) and phenols (11.33±0.18%) were the most abundant compounds detected in the sample. The saponin content values were found to be much higher than those reported for others spices like ginger (0.80%), pepper (7.40%) and garlic (4.60%)[15].

For instance saponins are known in reduction of glucose level and in hypocholesterolemic properties. This could help users in fighting against heart diseases[36].

Phenols were the second most abundant compounds in tumeric after saponins. This result correlated with the fact observed in other work[7] indicating a high level of polyphenol in turmeric than in ginger (174 & 55mg/100g respectively). Recent studies on tumeric have confirmed the fact that the sample contained a high level of phenolic compounds[16].

Phenols are reported to be the main contributors of antioxidant activity in plants[2]. This may be valuable for turmeric only due to the lower amount of phenols in ginger.

Anthocyanin constituents (0.40±3.92%) were found to have a lower concentration in ginger than in *C.longa* (02.33±0.16%). The finding that anthocyanins are the most abundant flavonoids of the red fruits[37] agree with the results of the present study since these compounds in the rhizomes as non colored samples were found in lower concentrations.

Anthocyanins play a role in health-preventive effects and reduce risks of, for example, age-related macular degeneration[38], they also reduce the risk of cardio vascular disorders[39].

Carotenoids were detected as trace compounds in both the plant samples with the smallest concentrations of 0.02±0.003 to 0.02±0.01%. This fact correlates with that observed for Ginger[15]. Moreover, carotenoids were not detected in garlic. It have been reported that the high values of carotenoids (29.3 &132.9mg/100g) lie to the red color of plant like pepper varieties[40]. As observed for anthocyanins such finding may justify the lower concentrations recorded in the present study as non colored samples.

Glycosides were not detected in any of the plants screened in the present study.

The variations in phytochemical levels may be explained by different factors such as environmental conditions, harvesting season, sampling techniques, the disparity of these compounds, genetic differences, and solvent used[41-44].

The presence of phytochemicals in *Capsicum annum* and *Capsicum frutescens* determine the medicinal value of these spices and their importance in nutrition due to the biological properties of these compounds.

Conclusion

The comparative study of the two spices, ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) indicated that they contained phytochemical constituents with beneficial health effects in treating common chronic diseases. Thus they could be considered as sources of useful drugs for improving the health status of consumers and as food need in nutrition as a result of the presence of various compounds that are vital for good health and could be recommended in food supplementation.

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