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Effect of Drying on the Composition of Secondary Metabolites in Extracts from Floral Parts of *Curcuma longa* L.

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PTM and TFM designed the study. Author PKM performed the statistical analysis. Authors LUM and NKN wrote the protocol. Author KTNN wrote the first draft of the manuscript. Authors CMM and GNB managed the analyses of the study. Author GNB managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: *Curcuma longa* is a rhizomatous herbaceous plant of Zingiberaceae family, originating from South Asia and very widespread in hot and rainy regions of the globe. The rhizomes are very popular spice and used as food additives for its coloring, aromatic, food preservation and nutritional properties.

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Aim: The aim of this study was to assess the drying effect of floral parts of *C. longa* at laboratory and incubator temperature (35°C) on the composition of secondary metabolites in general and polyphenolic compounds in particular.

Place and Duration of Study: The study was carried out at the Laboratory of Natural Products, Department of Chemistry, Faculty of Sciences, University of Kinshasa between November 20 and December 10, 2016.

Methodology: Floral parts of *C. longa* were collected. Petals were collected every day while sepals were collected 20 days after the first petal appeared. The phytochemical screening was used as per the standard protocol and it was assessed between floral parts dried in the laboratory temperature and floral parts dried in the incubator at 35°C.

Results: The findings revealed the presence of total polyphenols, flavonoids, and tannins in petal extracts dried in the incubator at 35°C. However, flavonoids and tannins were not detected in extracts from petals dried in the laboratory temperature. Phytochemical screening findings of the organic phase of *C. longa* floral parts revealed the presence of free quinones and terpenes in sepal extracts dried in the incubator at 35°C while those of extracts from the same part of the dried plant in the laboratory temperature revealed the presence of terpenes and steroids.

Conclusion: Future studies should carry out a similar study using the spectrophotometry method to determine polyphenolic compounds and confirm our hypothesis on the degradation of polyphenolic compounds during the drying of *C. longa* floral parts in the laboratory temperature.

Keywords: Curcuma longa; phytochemical screening; effect of drying; laboratory; incubator.

1. INTRODUCTION

Curcuma longa or saffron is a rhizomatous herbaceous plant, perennial, 50 cm to 1m high, of the Zingiberaceae family, originating from South Asia and it is very widespread in hot and rainy regions of the globe such as Asia, Africa and Oceania [1]. It is widely cultivated in India but also to a lesser extent in China, Taiwan, Japan, Burma, Indonesia and Africa. The intense cultivation of this plant is due to its rhizomes [1,2]. This latter dried and powdered are a very popular spice and are used as food additives for its coloring, aromatic, food preservation and nutritional properties. In addition, *C. longa* rhizomes are a key ingredient in traditional South American and Asian medicines such as Ayurvedic medicine (Indian medicine). Thus, *C. longa* is a remedy against gastrointestinal, digestive disorders, inflammatory diseases, skin diseases, etc. [1-5].

Numerous studies correlated with the ancestral knowledge have demonstrated the preventive action of *C. longa* rhizomes on many diseases such as cancers, cardiovascular diseases [6]. However, other studies have shown that extracts from *C. longa* rhizomes possess a large pharmacological potential namely: anti-cancer, anti-inflammatory, healing, cholesterol-lowering, hypoglycemic, anti-Alzheimer's, antiplasmodial, anti-inflammatory, antioxidant, antibacterial, antifungal, anti-venomous, antipyretic, analgesic, inhibits the action of HIV-1 integrase, and HIV-1 integrase protein replication, protects against diabetic retinopathy and many other pathologies [2-5,7-12]. In addition to rhizomes, the other organs of the plant (leaves, roots and floral parts) are less used. The leaves of *C. longa* are sometimes used in cooking or for the extraction of essential oils [5]. Ritwiz et al. [13] have shown that extracts from the leaves of *C. longa* have antioxidant, antibacterial potential and can modulate immunological properties. Meanwhile Mbadiko et al. [11,12], reported that total methanol extracts of rhizomes, roots, leaves and floral parts (petals and sepals) possess an anti-sickling activity. Most of the studies carried out so far focused only on the rhizomes of the plant, studies on the leaves, roots and floral parts of *C. longa* remain poor or less reported. This justifies our interest in carrying out a phytochemical study on the extracts of the floral parts (petals and sepals) of *C. longa*.

In addition, Mbadiko et al. [11,12] reported that floral parts of *C. longa* contained low levels of secondary metabolites (polyphenolic compounds) and thought this was related to the drying effect. These authors reported that during the drying of *C. longa* floral parts, and in particular, the petals in the laboratory temperature, these latter tended to soften and lose color, suggesting degradation of the phytoconstituents under cellular conditions. The negative impact of post-harvest treatments of plant samples on phytoconstituent composition has also been reported by Singh et al. [14].

Meanwhile, the degradation of polyphenolic compounds in plants under cellular conditions, i.e. fresh samples, has also been reported by Yan et al. [15] and Chang et al. [16]. Thus, this study is part of a context to assess the effect of post-harvest treatments, in particular the effect of drying on the composition of secondary metabolites in extracts from *C. longa* floral parts. The aim of this study was to assess the drying effect of floral parts of *C. longa* in the laboratory temperature and in the incubator (35°C) on the composition of secondary metabolites in general and polyphenolic compounds in particular.

2. MATERIALS AND METHODS

2.1 Collection of Plant Material

As biological material, the floral parts of *C. longa* were used. It was observed that *C. longa* renews its petals every 24 hours. Thus, petals were collected every day (between November 20 and December 10, 2016). The sepals were collected 20 days after the first petal appeared.

2.2 Packaging of Plant Material

After the collection, the petals and sepals were cleaned, washed quickly with tap water. Some of our samples were dried at the laboratory temperature and the other part at the incubator (Melag Nurfur Wechselstrom brand) at 35°C.

2.3 Preparation of Aqueous and Organic Extracts

The aqueous extracts were obtained by macerating 5 g of the powder of our four samples each in 50 mL of distilled water during 24 hours in the laboratory temperature, then filtered using filter paper (Whatman n°1). Maceration of 2 g of the powder from our samples in 20 mL of ethyl acetate during 24 hours of incubation then filtered using a filter paper (Whatman n°1).

2.4 Phytochemical Screening

Phytochemical screening represents all the qualitative techniques used to determine or identify the different chemical groups (secondary metabolites) contained in an extract. These chemical groups are identified by means of coloring and precipitation reactions that take place by adding specific reagents [11,17].

3. RESULTS AND DISCUSSION

The phytochemical screening of aqueous of *C. longa* floral parts dried in the laboratory temperature and in the incubator at 35°C is presented in the following Table 1.

Table 1 shows that the aqueous phases of different floral parts (petals and sepals) of *C. longa* dried in the incubator at 35°C differ in their composition in secondary metabolites. Total polyphenols, flavonoids, and tannins were detected in petal extracts. On the other hand, the analysis on sepal extracts revealed the presence of total polyphenols, flavonoids, anthocyanins, alkaloids and tannins. It should be noted that saponins were not detected in all extracts. While the extracts *C. longa* petals dried in the laboratory possess total polyphenols and alkaloids while the presence of total polyphenols, anthocyanins, tannins and alkaloids have been highlighted in sepal extracts.

It should be noted that total polyphenols was detected in the petal extract dried in the laboratory temperature and in the incubator at 35°C. For the sepal extracts, total polyphenols, anthocyanins, alkaloids and tannins were found in both settings.

Table 1. Phytochemical screening of aqueous phase of floral parts dried in the laboratory temperature and in the incubator at 35°C

Secondary metabolites	Laboratory temperature	Incubator (35°C)	Laboratory temperature	Incubator (35°C)
	Petals		Sepals	
Saponines	-	-	-	-
Total polyphenols	+	+	+	+
Flavonoids	-	+	-	+
Anthocyanins	-	-	+	+
Leuco-anthocyanins	-	-	-	-
Alkaloids	+	-	+	+
Bound Quinones	-	-	-	-
Tannins	-	+	+	+

Legend : + :presence of the phytoconstituent, - :absence of the phytoconstituent

Table 2. Phytochemical screening of organic phase of *C. longa* floral parts dried in the laboratory temperature and in the incubator at 35°C

Secondary metabolites	Laboratory temperature	Incubator (35 °C)	Laboratory temperature	Incubator (35 °C)
	Petals		Sepals	
Terpenes	-	+	+	+
Steroids	-	-	+	-
Free Quinones	-	+	-	+

Legend: +: presence of the phytoconstituent, - : absence of the phytoconstituent

Table 2 above shows that the organic phase of extracts from different floral parts of *C. longa* dried in the incubator at 35°C has the same chemical profile. The presence of terpenes and free quinones has been detected in both parts of the plant. Meanwhile for the petal extracts dried in the laboratory temperature didn't show any compounds, but in the sepal extracts only terpenes, and steroids were found. It should be noted that only terpenes was found in sepal extracts for both settings.

3.1 Discussion

Phytochemical analyses in this study revealed the presence of total polyphenols, flavonoids, tannins in petal extracts dried in the incubator at 35°C. However, flavonoids and tannins were not detected in extracts from petals dried in the laboratory temperature. This implies their degradation under laboratory conditions. In fact, since biochemical reactions necessarily occur in an aqueous environment, drying at a temperature that does not remove moisture at a short time would favor the action of certain enzymes that are activated during drying [18], could be at the origin of the degradation of certain secondary metabolites. As mentioned above, the degradation of polyphenolic compounds in fresh plant samples has also been reported by Yan et al. [15] and Chang et al. [16].

In addition, the phytochemical screening of sepal extracts dried in the incubator at 35°C revealed the presence of total polyphenols, flavonoids, anthocyanins, tannins and alkaloids while those of sepals dried in the laboratory temperature showed the presence of total polyphenols, anthocyanins, tannins and alkaloids. The absence of flavonoids in sepals and petals dried in the laboratory temperature would suggest their degradation during drying; this would justify at the same time the discoloration of these samples during drying. Indeed, flavonoids are pigments responsible for the yellow, orange and red discoloration of different plant organs [19]. Further studies are needed to confirm this hypothesis.

Phytochemical screening findings of the organic phase of *C. longa* floral parts revealed the presence of free quinones and terpenes in sepal extracts dried in the incubator at 35°C while those of extracts from the same part of the dried plant in the laboratory temperature revealed the presence of terpenes and steroids. Phytochemical screening of petal extracts dried in the incubator at 35°C showed the presence of free quinones and terpenes. These compounds were not detected in petal extracts dried in the laboratory temperature. The absence of quinones in sepal and petal extracts dried in the laboratory temperature could justify the discoloration of these organs during drying in the laboratory temperature and would affirm their degradation during drying. Boukri [19] reported that quinones are colored and bright substances, usually having red, yellow or orange colors.

4. CONCLUSION AND RECOMMENDATIONS

The purpose of this study was to assess the drying effect of floral parts (petals and sepals) in the laboratory or incubator temperature at 35°C on the composition of secondary metabolites in general and polyphenolic compounds in particular. In light of the findings obtained, we believe that drying the floral parts (petals and sepals) of *C. longa* in the laboratory temperature would promote the degradation of certain polyphenolic compounds (flavonoids and quinones). This would prevent the action of certain enzymes that would be activated after harvest or during drying and would prevent the degradation of polyphenolic compounds. Samples should also be cut into small pieces before drying to increase the surface area of contact of the samples with heat and rapidly reduce moisture. The study on the drying effect on the composition of secondary metabolites has not yet been reported in the literature.

Future studies should carry out a similar study using the spectrophotometry method to determine polyphenolic compounds and confirm our hypothesis on the degradation of polyphenolic compounds during the drying of *C. longa* floral parts at laboratory temperature.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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