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PHYSICOCHEMICAL QUALITIES OF SPICES SOLD ON THE N'DJAMENA MARKET

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ABSTRACT
The present study aims to assess the physicochemical qualification by chromatography of the different species of spices sold on the N'Djamena market. This was a prospective, multisectoral study with an analytical aim on the different spices analyzed at CECOQDA in N'Djamena-Chad. AFNOR standardized methods were used. Data entry and analysis were done using SPSS software. The search for the degree of significance was obtained using Duncan's test at the 0.05 probability threshold. The high water content of fresh celery (75.80%), fresh pepper (55.28%), fresh garlic (49.54%) and fresh ginger (47.78) was significant. The low water content was observed for samples of dry garlic (06.63%) and dry ginger (07.06%)). Samples of fresh garlic and fresh ginger showed high ash content of 63.25% and 41.27%, respectively. In contrast, celery and pepper all fresh had an ash content of 12.4% and 13.43% respectively. A low ash content was obtained with the samples of dry ginger and dry garlic that had 05.52% and 05.59% respectively. Dried gingers contained a high level of lipids (7.80%) followed by fresh gingers and celery which had 3.54% and 3.00% of lipids, respectively. Total nitrogen content fluctuated between 0.53% for bell pepper and 4.05% for dry garlic. Thus, the garlic samples contained a significant amount of protein than other spices. In addition, dry garlic and dry ginger samples were observed to have higher protein levels than fresh samples. Spices constitute a protein supplement during culinary practices. Certain spices could be good sources of vegetable lipids and could be more valued, if their fatty acid profile present interesting nutritional qualities that deserve to be investigated.

KEYWORDS: spices, physicochemical qualities, N'Djamena-Chad.

INTRODUCTION
Humans have used tropical spices since ancient times. Their virtues are expressed through their culinary, coloring and fragrant interests, but also in traditional medicine. Good preservation will help us to avoid contamination of microbes as well as the deterioration of its physicochemical factors.[1] Four (4) varieties of spices from fruits, leaves and bulbs were proposed in our study: garlic, celery, ginger and bell pepper.

Garlic or ***Allium sativium L*** (South Asia) is a perennial vegetable plant, belongs to the Liliaceae family. Louis Pasteur was one of the first to demonstrate the bactericidal effect of garlic. Thus, the British (1916) and Russian (1939-1945) army resorted to garlic when it ran out of penicillin.[2,3] On the superfood and health list, garlic is rich in manganese, copper, phosphorus, potassium, zinc, vitamin C, flavonoids, tocopherols, selenium and allicin. Thanks to its antibacterial and antibiotic properties, it helps the body fight against certain forms of infection to which it may be exposed.[4] Eating a raw clove of garlic every day can lower cholesterol levels by 20%.[5] It is useful in moderate arterial hypertension and helps restore good blood circulation in peripheral circulatory failure.[5] Several studies have shown that individuals who consume garlic and vegetables from the Liliaceae family have a lower risk of developing certain types of cancer, including cancers of the digestive system such as cancer of the intestine, stomach or breast.[5] Garlic is recognized as an adjunct to dietary measures against hyperlipemia and in the prevention of vascular disorders associated with aging (atherosclerosis).[6] According to Chinese researchers, garlic has antioxidant and anti-inflammatory effects and prevents or reduces glycation, making it an interesting agent for slowing the progression of complications of diabetes.[7]

Celery or ***Apium graveolens*** (Mediterranean region) belongs to the Apiaceae family. Epidemiological studies have shown that a high consumption of vegetables and fruits decreases the risk of cardiovascular disease, certain cancers, and other chronic diseases.[8, 9, 10] The presence of antioxidants in vegetables and fruits may play a role in this protection. A daily dose of celery can potentially prevent dementia and cognitive impairment by improving blood flow to the brain, helps improve our well-being by flushing toxins from our bodies, helps treating arthritis, rheumatism and gout. It alleviates the pain of people who have a problem with the sciatic nerve.[11, 12]

Certain compounds contained in celery (polyethylenes) are believed to be able to prevent the proliferation of several types of human cancer cells in vitro.[10] Celery seeds have also been shown to protect against the formation of liver cancer cells in animals. Celery seeds are also believed to contain apigenin, an antioxidant with anti-cancer effects. Celery provides a dietary intake of lutein (an antioxidant from the carotenoid family), potassium, rich in vitamins (A, B1, B2, B9 and C), magnesium, iron, phosphorus and folic acid.[10, 13]

Celery aids digestion, promotes the production of hydrochloric acid in the stomach for better digestion of food. Prolonged contact with the plant followed by exposure to the sun can cause skin damage. Acute phytophotodermatitis is mostly observed in farmers or workers in processing industries.[14]

Ginger or ***Zingiber officinale*** from the Zingiberaceae family was once used in the composition of mummification techniques practiced in Ancient Egypt. A condiment and medicinal plant for more than 3000 years is native to India.[15] The ginger rhizome is known for its contribution to food, has antioxidant potential. Today, pharmacists across the world use ginger extract for many therapeutic applications, its reputation as a potent aphrodisiac spice that improves digestion. Thanks to its emetic, it also reduces nausea and vomiting. It is rich in minerals like manganese, phosphorus, magnesium, but also contains calcium, sodium and iron. From a nutritional point of view, the caloric intake of ginger is estimated at 332 Kcal per 100g of fresh plant. This contribution comes mainly from carbohydrates (total 70g, starch 55g, sugar 3.5g, fiber 14g), protein 9g and lipids 6g.[15, 16, 17, 18]

The pepper or ***Capsicum annuum L*** is a herbaceous plant of the Solanaceae family (native to tropical America), nearly 60 cm long, red, green or yellow in color. Peppers contain a low percentage of protein (0.89%) and carbohydrates (4.43%) and almost no fat (0.19%). They contain small amounts of vitamin E, all minerals, beta-carotene and carotenoids like lycopene. A powerful antioxidant protects against cancerous degeneration of cells.[19] Other non-nutritive substances also characterize peppers. Flavonoids are powerful antioxidants which act as anti - inflammatory and protectors of the circulatory system. Capsaicin is a substance responsible for spiciness. In low doses, it is an aperitif and stimulates digestion. It contributes to the laxative action of peppers. The peppers would help to lose weight. Research has shown that capsaicin prevents the development of immature fat cells. Research published in 2009 in the International Journal of Cancer showed that women near menopause who ate two or more meals daily rich in carotenoids reduced their risk of breast cancer by 17%, stomach conditions, constipation, diabetes and obesity and the prevention of cancer of the digestive tract.[20, 21]

The physico-chemical parameters of these spices sold on the market are not well known. Few studies in this direction were carried out. The population for healing uses these spices empirically. The population poorly understands the antioxidant properties. However, these spices have interesting virtues in the treatment of certain diseases.

The object of our study is to establish the physicochemical properties of the different species of spices purchased on the N'Djamena market.

MATERIAL AND METHODS

This was a prospective, multisectoral study with an analytical aim on the different species of spices (garlic, celery, dry and fresh ginger and pepper) marketed in the N'Djamena market.

Each sample was taken under the usual conditions of sale and packaged in carefully closed sterile bags, then placed in a cooler. The latter was sent to the N'Djamena-Tchad Food Quality Control Center (CECOQDA). The food spice samples were washed, cut up, dried at 105 ° C until the water had completely evaporated to obtain the dry matter and then ground for analysis or for subsequent storage. The ash content was determined using the AOAC 920.87 (1990) method (AFNOR, 1993 or various AOAC methods), the lipid content by the Soxhlet method taken from the ISO 660 standard, 1983. The total nitrogen content / crude protein is based on the transformation of organic nitrogen into mineral nitrogen in ammoniacal form (NH4) 2SO4 by the oxidative action of sulfuric acid boiling on organic matter in the presence of a catalyst. A part of these cut spices was directly used for the parameter known as the determination of the water content or humidity rate (method 925.10; AOAC, 1990).[22] The test results obtained in this study were presented as the mean ± standard deviation, which means were subjected to one-way analysis of variance (ANOVA) to check for any significant differences between them. This was done using IBM SPSS software version 22.0. In the absence of equality of the means, the latter were compared with each other for the search for the degree of significance using Duncan's test at the probability threshold 0.05.

RESULTS

Samples of garlic, gingers, celery and peppers for analysis showed no signs of deterioration.

The water content, the ash content, the lipid content and the nitrogen content are listed in the table below.

Table: The spices studied, the water content, ash content, lipid content and nitrogen or crude protein. Sample Water content Ash content Lipid content Nitrogen content.

Sample	Water content (%)	Ash content (%)	Lipid content (%)	Nitrogen content (%)
Fresh garlic	49.54 ± 1.71^{ab}	63.25 ± 0.03^{d}	**1.39 ± 1.26^{b}**	3.32 ± 0.01^{b}
Dry garlic	**06.63 ± 0.11^{a}**	**05.59 ± 2.57^{a}**	0.98 ± 0.04^{a}	4.05 ± 0.02^{c}
Fresh ginger	**47.78 ± 0.63^{bc}**	41.27 ± 2.50^{c}	3.54 ± 0.45^{d}	**0.99 ± 0.00^{a}**
Dry ginger	**07.06 ± 0.16^{a}**	**05.52 ± 0.08^{a}**	7.80 ± 5.36^{e}	**1.13 ± 0.00^{a}**
Celery	75.80 ± 2.38^{c}	**12.48 ± 0.95^{b}**	3.00 ± 1.12^{c}	**1.14 ± 0.00^{a}**
Pepper	**55.28 ± 2.28^{bc}**	**13.43 ± 0.98^{b}**	**1.82 ± 0.86^{b}**	**0.53 ± 0.01^{a}**

The values on the same column with different letters are significantly different at the $p < 0.05$ threshold.

DISCUSSION

The water content gives an idea of the favorable conditions for the development of microorganisms in spices liable to alter them. Our study highlights the results of the moisture content of the different spices analyzed. From this table, it can be seen that the moisture content of these spices varies considerably ($p < 0.05$) between samples. These results show that spices can be classified into two large groups. Fresh spices with high water content with significant differences (fresh celery (75.80%), fresh peppers (55.28%), fresh garlic (49.54%) and fresh ginger (47.78)) and dry spices with low water content (dry garlic (06.63%) and dry gingers (07.06%)).

The low water content of the samples of dry garlic and ginger is thought to be due to the fact that the latter underwent a preamble to dehydration by drying in the sun which would have eliminated a large part of the water. These relatively low water contents give the spice powders greater stability and therefore rather long storage. This peculiarity is of capital importance, due to the fact that spices are very often used over a long period of time, hence the need for prior treatment. Similar results were obtained by Tchiégang and Mbougueng in 2005[23] on spices sold in the market in Cameroon. The variation in water content from one spice to another corroborates the results obtained by Songré-Ouatara and al. in 2016[24] which showed that the water content of spices varies from one spice to another and depending on whether or not this spice has undergone a heat treatment likely to cause its loss of water. The high water content of spices would lead to their rapid degradation resulting in the appearance of molds, yeasts and promotes bacterial development when they are stored.

Total ash is the residue of mineral compounds that remains after incineration of a sample containing organic substances of animal, plant or synthetic origin. The averages of the ash content of our different spices are presented with significant differences or not. It emerges from this table that the samples of fresh garlic (63.25%) and fresh ginger (41.27%) are those with a high rate of ash and therefore a high quantity of minerals followed by celery (12.48%).) and peppers (13.43%) all sampled fresh. However, low ash levels were obtained with non-significant differences for the samples of dry garlic (05.59%) and dry gingers (05.52%). As a result, the ash content of spices varies from one spice to another and depending on the treatments they have undergone. These observed values are higher than those reported by Tchiégang and Mbougueng in 2005 who found values ranging between 2 and 9%.[23] The same is true for Abdou Bouba in 2009, whose spice ash content varied between 7.7% and 10.5%.[25] This high ash content shows that spices in general could be a potential dietary source of minerals. In fact, no significant variation ($p < 0.05$) in ash content between fresh garlic and fresh ginger as well as dry ones on the one hand and between celery and peppers on the other hand was observed. These results indicate that approximately 0.1g of the mineral could be provided by consuming 1g of spices.

The lipid content of different food spices used in this study varied significantly ($p < 0.05$). It appears that dry gingers contain a high amount of lipids (7.80%) followed by fresh gingers and celery which respectively have 3.54% and 3.00% lipids. However, very small amounts of lipids are recorded in the samples of fresh (1.39%) and dry (0.98%) garlic as well as peppers (1.82%). The lipid contents obtained for our spices are much lower than those determined by Tchiégang and Mbougueng in 2005, on the same spices purchased on the markets in western Cameroon.[23] This difference could be due in part to the extraction method used. Indeed, the method of Folch and al., In 1957[26] uses a cold extraction technique with methanol / chloroform which allows the extraction of total lipids. Therefore, it gives a better yield whereas the hexane extraction we used only extracts the neutral lipids. In addition, Vallilo and al., In 1999 found higher levels on nuts of Lecythis pisonis Camb (61.3%) in São Paulo in Brazil[27], similarly Glew and al., In 2004 found also high lipid contents in some of the spices studied

(40% -47.0%) in Niger.[28] Guohua and al., In 2006 found average lipid contents in ***Allium tuberosum*** seeds of 15.8% in China.[29]

It can be seen in this table that the protein content varies significantly ($p < 0.05$) between the spices. It can be noted that the total nitrogen content fluctuates between 0.53% (pepper) and 4.05% (dry garlic). Thus, garlic samples contain a higher amount of protein than other spices. In addition, it is observed that the samples of dry garlic and dry ginger have higher protein levels than the fresh ones. This could be explained by the fact that the heat treatment to which these spices are subjected by sellers and resellers with a view to good preservation, makes them available and therefore increases their protein content. Low amounts of protein are found in fresh gingers and peppers. We can therefore conclude from these values that spices could constitute a protein supplement during culinary practices. These results are lower than those obtained by Jiyu and al. in 2007 on certain cultivars of ***Myrica rubra*** (27.83% - 29.91%) in China and in essential amino acids.[30]

CONCLUSION

Fresh spices have a high water content with significant differences. Fresh garlic and fresh ginger samples are those with a high ash content and therefore a high amount of minerals. Dried gingers contain a high amount of fat compared to others. The total nitrogen content fluctuates between 0.53% and 4.05%.

From the results obtained in this study, one can think that spices could constitute a protein supplement during cooking practices. Certain spices could be good sources of vegetable lipids and therefore could be more valued, if their fatty acid profile present interesting nutritional qualities that deserve to be investigated.

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