


REVIEW ARTICLE

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Valorization of *pikliz*: a spicy meal garnishment in Haitian cuisine

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Abstract

The biochemical process of fermentation (zymology) is widely practical for foods and beverages. This metabolic process involves microorganisms (bacteria) and their enzymes in the preparation and preservation of foods. Many studies have shown that fermented foods and beverages have various documented health benefits to humans, such as being high in vitamin b, and, among other benefits, having atherogenic and anticarcinogenic properties. This communication discusses the significance of fermentation in Haitian cuisine by focusing on *pikliz*—a spicy fermented meal garnishment that is widely popular among Haitian dishes. This analysis provides relevant information on Haitian cuisine while examining the underlying mechanisms, compositions, properties, nutritional values, and potential health benefits of *pikliz*. This spicy meal garnishment represents the regional, ethnic, and national identity of Haitians living in Haiti and abroad.

Keywords: Cabbage, Carrot, Fermentation, Haitian cuisine, *Pikliz*

Introduction

Historical overview of Haitian cuisine

Prior to the Europeans' arrival to the Caribbean island of *Ayiti*, otherwise known as *Ayiti Quisqueya* (present-day Haiti and Dominican Republic), the island was inhabited by the native indigenous people, called the Taino [1, 2]. At the time, the island (Fig. 1) was divided into five regions: Magua, Marien, Jaragua, Maguana, and Higüey, where each region was governed by a *Cacique*—Taino Chief. As Christopher Columbus took possession of the island in 1492, he renamed it to *La Isla Española*, which was later changed to Hispaniola [3]. The Spanish ruled the island from 1492 to 1625, where later, the French received and established their colony in the western region, historically called Saint Domingue and is present-day Haiti (Fig. 1). The Frenchmen oppressed Haiti by creating a slavery-based agricultural system used to exploit the richness of the land. They did so by importing a vast number of Africans to the island and

forced them to work as slaves under harsh conditions in various plantations (i.e., coffee, sugar, cocoa, tobacco indigo, and cotton among others). Nonetheless, the slaves revolted and gained their independence from France in 1804. Following the Haitian Revolution, the influences of the various ethnic groups who populated the island remained evident in the Haitian society—from the language to the cuisine.

The culinary blend of the African, French, Taino, and Spanish cultures helped to develop and establish the nature of Haitian cuisine [4] along with the later influences from Levantines, due to Arab migration over the years [5]. For instance, the Taino natives first introduced barbecue, or barbeque (BBQ), to Haitian cuisine, then to the world. The Africans introduced okra, also called gumbo (*kalalou*), and other various vegetables roots (i.e., yam, taro, and cassava), fruits, and spices. As for Spanish influence, it is well known that the style and technique of Haitian cooking are similar to those of Latin America, but with many technical variations. Haitian food independently maintains a unique flavor compared to its Latin Caribbean counterparts.

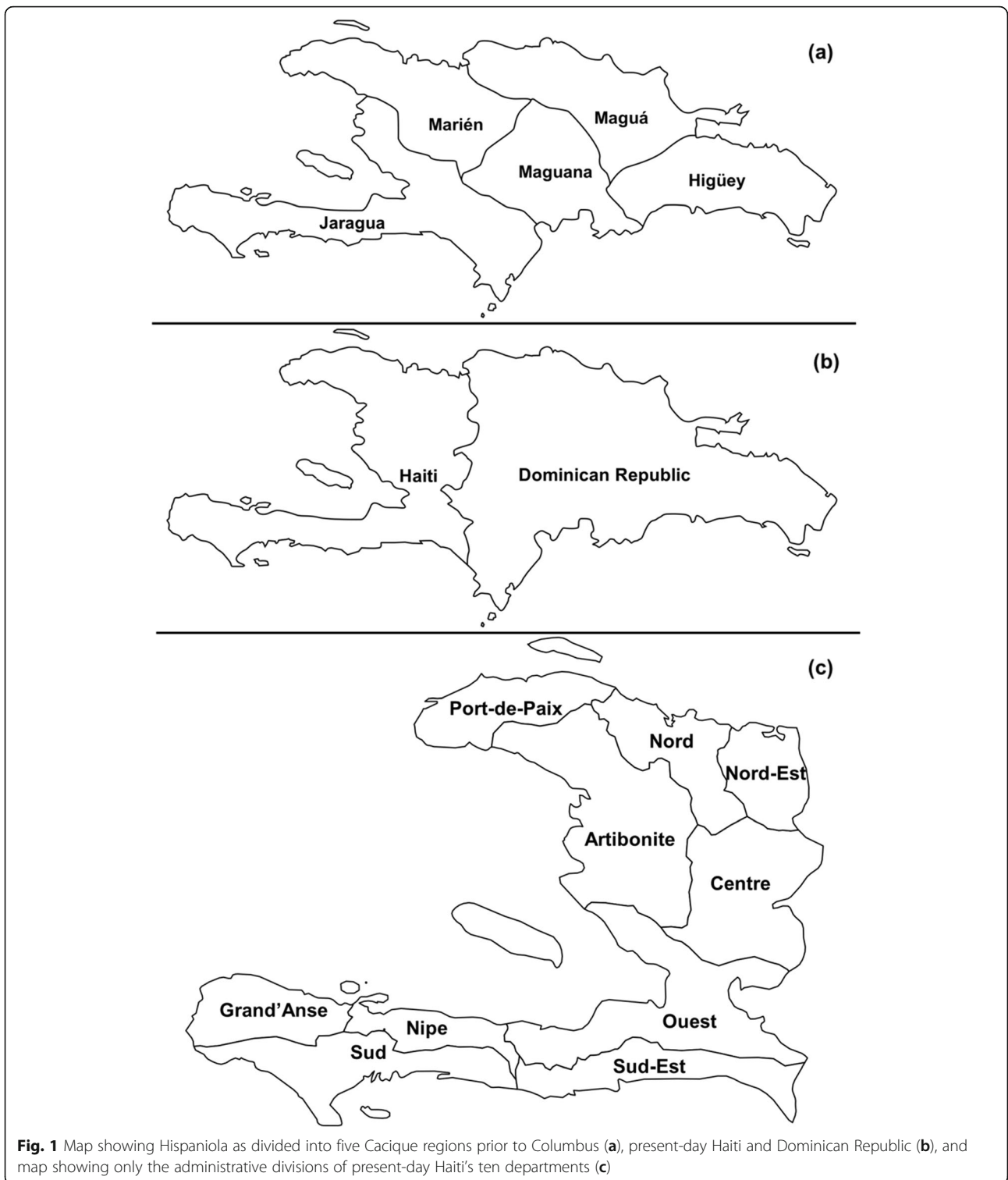
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Haitian cuisine is largely based on the liberal use of *epis*—an assortment of herbs and spices. A typical *epis* consists of garlic, green onion, thyme, salt, and pepper, all crushed to form a paste-like mixture. It is generally used to season and prepare all types of meat, seafood,

légume (a thick vegetable stew), bean purée (*sauce pois, sòs pwa*), rice (*diri kole; diri djon-djon*), and Haitian spaghetti among other dishes. Although the form of *epis* differs among cuisines, its use is an essential requirement in Haitian cuisine, Creole cuisine.

Since typical Haitian religions, like Christianity and Voodoo, are important aspects of the culture, several dishes are typically prepared for religious gatherings and celebrations. The same applies to cultural holidays such as Haiti's Independence Day, where the freedom from slavery is celebrated through pumpkin soup (soup joumou). Of all the mentioned dishes and many others, they are not complete until a lump sum of *pikliz* is accompanied beside each meal. While the origin of *pikliz* historically remains unknown, this spicy meal garnishment represents the regional, ethnic, and national identity of Haitians living in Haiti and abroad. As the population of Haitians who reside outside the country continues to increase, they continue to represent and share their culture and cuisine to the world. In the USA, Canada, and France, where a majority of Haitians reside, the annual Haitian Food Festival is considered an important event for Haitians to share and celebrate the richness of their cuisine.

Pikliz and its process

Understanding pikliz

The name *pikliz* (pronounced PEE-kleez) can be understood based on the word pickle and the French word *piquer* (meaning to sting). Pickle is derived from the Dutch word *pekel* and from the Northern German word *pókel* (both meaning brine). The pickling process preserves and extends the lifespan of food through a process known as anaerobic fermentation, where food is soaked in in a brine solution or vinegar solution for a long period of time [6]. Meat, fish, eggs, and vegetables are commonly and historically known to have systematically undergone pickling. This process not only preserves the food, but it also affects the taste, flavor, and texture of the food. In various regions of the world, the term pickle is

typically referred to pickled cucumber, egg, or onion. While the origin of pickling remains unknown, credit is given to the ancient Indus Valley Civilization of the Mohenjo Dara (Northwest of the Indian continent) about 2400 BC.

Pickling remains as one of the oldest methods used for food preservation, found in many parts of the world. Such process is said to have been brought to Hispaniola during the European exploration age, and emerged into Haitian cuisine in the form of *pikliz*. *Pikliz* is a condiment made from shredded cabbage and carrot mixed with an extensive amount of peppers (*piment*) and spices, all immersed in vinegar or lemon juice [7–9]. The nature of this process can be chemically explained by the production of *lactobacillus plantarum*; and of alcohols and acids which form aromatic compounds from *leuconostoc mesenteroides* during fermentation [10]. These bacteria species, *lactobacillus* and *leuconostoc*, are associated with fermentation under salinity condition in high and low temperatures, respectively. The acidity media (pH 4 or lower) [11] and the antimicrobial properties of the spices [12] serve to preserve and kill most bacteria in the *pikliz* while enhancing its flavor during fermentation. Overall, the acidity and salinity of the solution from the vinegar and spices along with the temperature of fermentation regulate the microorganism species, which determine the final flavor of the *pikliz*.

This spicy fermented meal garnishment, *pikliz*, has long been prepared at the household level in Haiti; however, as the number of Haitians living abroad continues to increase, commercialization of *pikliz* on an industrial level has systematically increased (Fig. 2). Nowadays, *pikliz* can be purchased at major supermarkets in the USA, such as Walmart®, Publix Market®, and other regional supermarkets (Fig. 2). Altogether, *pikliz* remains the symbol of Haitian culture (Figs. 3 and 4).



Fig. 2 Selected photographs of various *pikliz* brands available at designated grocery stores and online markets [13–15] throughout the USA as commercialization of *pikliz* continues to increase among Haitians living at home and abroad



Fig. 3 A typical Haitian meal (*fritay*) served with *pikliz*. Left to right: fried plantain (*bannann peze*), malanga fritters (*akra*), *pikliz*, and fried pork (*griyo*) as prepared by *Manje*, a Caribbean fusion catering service in Fargo, North Dakota [16]

Dissecting *pikliz* components

Cabbage—Brassica oleracea

Cabbage, a member of genus *Brassica* and *Brassicaceae* (mustard family), is high in nutritional value [17]. A 100 g size of raw cabbage (Table 1) contains vitamin C (44%), vitamin K (72%), vitamin B (35%); (Table 2) various minerals (i.e., zinc and potassium, 1–8%) and some of 103 kJ (25 kcal) of energy (Table 4) [18]. The pickling process could improve the nutritional value of the cabbage (B vitamins) which is produced by bacteria [19]. These vitamins are water-soluble and are necessary for cell metabolism.

Cabbage can be prepared in various ways for consumption. This includes steaming, stew, *sautéé*, braise, and pickle. The pickling method (Table 3) remains most popular for *pikliz* in Haitian cuisine; *sauerkraut* in Azerbaijani, Belarusian, Polish, Russian, Baltic states, and Ukrainian cuisine; *kimchi* in Korean cuisine; *suan cai* in Chinese cuisine; and *curtido* in Salvadorian cuisine and other Central American cuisines [17, 20–22].

Although cabbage has been cultivating around 1000 BC [23] in central and western Europe and introduced to America around the 1540s [24], scientists are not yet able to fully study the health benefits of cabbage. As the plant consists of sulforaphane and glucosinolate, phytochemical studies of cabbage to understand the health benefits and anti-disease properties of the plant are undergoing. The plant also serves as a great source of indole-3-carbinol [25]. These compounds could stimulate metabolism from the production of detoxifying enzymes [26]. Such cruciferous plant could also have protective effects against colon cancer [27], among other properties related to antioxidant [28], anti-atherogenic, and anticarcinogenic [29]. These properties are subjects of ongoing biomedical research [25].

Carrot—Daucus carota sativus

Carrot is a root vegetable belonging to the *Apiaceae* family which consists of mostly aromatic flowering



Fig. 4 Photographs of homemade *pikliz* as prepared using traditional family recipe and stored in sealed containers for fermentation. This process enhances the flavor of the *pikliz*, preserves its contents, and increases the lifespan of the *pikliz*

Table 1 Comparative vitamins data showing nutritional value per 100 g of raw material (cabbage and carrot) based on the data reported by United States Department of Agriculture (USDA)

Vitamins	Cabbage		Carrot	
	Mass ^a	DV ^b	Mass ^a	DV ^b
Vitamin A	–	–	835 µg	104%
Beta carotene	–	–	8.285 mg	77%
Lutein zeaxanthin	–	–	0.256 mg	–
Thiamine (B1)	61 µg	5 %	66 µg	6%
Riboflavin (B2)	40 µg	3 %	58 µg	5%
Niacin (B3)	0.234 mg	2 %	0.983 mg	7%
Pantothenic acid (B5)	0.212 mg	4 %	0.273 mg	5%
Vitamin B6	0.124 mg	10 %	0.138 mg	11%
Folate (B9)	43 µg	11 %	19 µg	5%
Vitamin C	36.6 mg	44 %	5.9 mg	7%
Vitamin E	–	–	0.66 mg	4%
Vitamin K	76 µg	72 %	13.2 µg	13%

^aMass are reported in milligrams (mg) and micrograms (µg)
^bPercentage daily value (DV) is based on USDA recommendations for adults. Food that provides 5% or less of the DV is considered a low source while food that provides 10% to 19% of the DV is a good source. Meanwhile, food that provides 20% or more of the DV is considered high in that nutrient. Refer to the USDA database for additional nutrient data

plants (i.e., *umbelliferae*). The word carrot is borrowed from French, *carrotte*, which first appeared in English in 1530. *Carrotte* itself is derived from Latin, *carota*, and from Greek, *καρωτόν* or *karōton*, with Indo-European root word *ker-* (meaning horn; head). This can be explained by the horn-like shape of this cultivar. Various colors of the cultivar have been cultivated around the world. This includes black, white, red, and yellow-orange carrots (Fig. 5) [30–32]. Historically, the plant has been cultivated for its taproots, stems, and leaves

Table 2 Minerals and water contents per 100 g of raw material (cabbage and carrot) based on the recommended values for adults as reported by the USDA

Minerals	Cabbage		Carrot	
	Mass ^a	DV ^b	Mass ^a	DV ^b
Calcium	40 mg	4%	33 mg	3%
Iron	0.47 mg	4%	0.3 mg	2%
Magnesium	12 mg	3%	12 mg	3%
Manganese	0.16 mg	8%	0.143 mg	5%
Phosphorus	26 mg	4%	35 mg	5%
Potassium	170 mg	4%	320 mg	7%
Sodium	18 mg	1%	69 mg	5%
Zinc	0.18 mg	2%	0.24 mg	3%
Water content	92.6 g	–	88 g	–

Legends (^a and ^b) are as described in Table 1 for the vitamins data

Table 3 Selected list of fermented cabbage food by similar processes that are found in various cuisines

Name	Cuisine
<i>Pikliz</i>	Haitian
<i>Sauerkraut</i>	Azerbaijani, Belarusian, Polish, Russian, Baltic states, Ukrainian, and German
<i>Kimchi</i>	Korean
<i>Suan cai</i>	Chinese
<i>Curtido</i>	Salvadorian
<i>Encurtido</i>	Nicaraguan
<i>Tsukemono</i>	Japanese
<i>Kiseli kupus u glavicama</i>	Romanian, Bosnian, Croatian, Serbian, and Bulgarian
Dill pickles	American, Eastern, and Central European
Chow-chow	North American
<i>Zasmażana kapusta</i>	Polish
<i>Choucroute</i>	French



Fig. 5 Various colors of carrots selectively bred with pigments reflecting most of the colors of the rainbow by the Agricultural Research Service (ARS) under the USDA. See the link in ref. [30] for additional details

consumption. While the green leaves are edible, they are seldomly consumed by humans due to their toxic naturally occurring alkaloid compounds [33–35]. Modern day carrot plants are selectively bred for a less wood-texture taproot. The vitamin contents (Table 1), mineral contents (Table 2) and nutritional values (Table 4) of carrots make the root of this cultivar very effective for a healthy diet. The root is a great source of vitamins (B6 and K) and contains a significant quantity of vitamin A and beta-carotene (provitamin A carotenoids). Carrot roots can be prepared in various ways for consumption. The root is widely used in various cuisines and can be boiled, steamed, fried, chopped (*carrotte julienne*), or pickled (i.e., *pikliz* and *sauerkraut*); in addition to the preparation of juice, salad, broth (*mirepoix*) [36], and even sweet dessert (i.e., carrot cake and carrot pudding). Carrots, as an *Apiaceae*, contain polyacetylene (oligoynes, carbinoids) compounds which exhibit cytotoxic activities [37, 38]. These compounds, namely, falcarinol and falcarindiol (cis-heptadeca-1,9-diene-4,6-diyne-3,8-diol) show antifungal activity against *myco-centrospora acerina* and *cladosporium cladosporioides* [39]. The latter compound is also responsible for the bitterness of carrot root [40]. Meanwhile, other compounds such as 6-hydroxymellein [41], 6-methoxymellein, eugenin, 2,4,5-trimethoxybenzaldehyde (gazarin), or (*Z*)-3-acetoxy-heptadeca-1,9-diene-4,6-diin-8-ol (falcarindiol 3-acetate) are also present in carrots and in the leaves (pyrrolidine) [42].

While the repetitive idea ‘carrot is good for your vision and it will make you see in the dark’ is constantly being shared as a myth, such idea is only valuable to individuals who suffers from vitamin A deficiency. Such deficiency remains a major public health issue in developing countries [43]. Intake of animal and plant sources, such as fruits and vegetables (i.e., carrot, apricot, papaya, mango, sweet pepper) rich in bioactive compounds could greatly reduce the rate of nutrition-related chronic diseases [44, 45] in these countries. This vitamin has major health benefits and plays an important role in vision, reproduction, bone growth, cell differentiation, and cell division [46–50]. Vitamin A regulates the human

immune system as it helps to fight and prevent infections more effectively by the production of white blood cells, which destroys viruses and bacteria [46, 51–55]. As nearly half of Haiti’s population has no access to basic healthcare services and about 30–50% of the children are vitamin A deficient [56, 57], surprisingly, a high intake of *pikliz* could systematically improve their health. This idea is coupled with the aforementioned health benefits of the main constituent of *pikliz* (cabbage and carrot). The incorporation of carrots to rock buns—a traditional snack food in Ghana, is suggested to highly improve the nutritional value of the snack through the integration of vitamin A [58]. This idea is based on efforts to minimize the vitamin A deficiency problem among Ghanaians. While only 3% of the vitamin (in the form of alpha and beta-carotene) is accessible from raw consumption of carrots, researchers have shown that the bioavailability of provitamin A could be greatly improved to nearly 40% from softening or breaking down the cell wall of carrots (i.e., cooking, baking, the addition of oil, fermentation) [58–66].

Conclusion

While the pickling process—fermentation of food items—remains very efficient in preserving food, many cuisines have incorporated such process in achieving fermented food with significant health benefits. The chemical nature of this process is governed by the production of *lactobacillus plantarum*, and of alcohols and acids which form aromatic compounds from *leuconostoc mesenteroides* during fermentation. The production of such beneficial microorganisms regulates and determines the final flavor of the food. The resulted fermented food is consequently enriched in various health benefits to humans as documented by many researchers. The effects of these benefits are crucial, especially to individuals with very little access to a well-balanced diet.

Fermented cabbage, *pikliz* as eaten in Haiti, remains a good source of provitamin A, vitamin B, vitamin C, valuable minerals, and contains anti-atherogenic, and anticarcinogenic, among other medicinal properties. Due to the many health benefits of *pikliz*, public health officials should teach and engage their communities with such information where basic healthcare services are not readily available [67]. This meal garnishment will not eliminate nor solve their health problems, but the incorporation of *pikliz*, which is rich in bioactive (fermentation derived) compounds, could greatly reduce the rate of nutrition-related chronic diseases.

While Haitian cuisine is influenced by various other cuisines: from the Indigenous to the Africans, the flavor of Haitian cuisine remains independently unique to Haiti. This spicy meal garnishment, *pikliz*, represents the regional, ethnic, and national identities of Haitians living

Table 4 Nutritional value per 100 g amount of raw material (cabbage and carrot) based on USDA recommendations for adults

	Cabbage	Carrot
Energy	103 kJ (25 kcal)	173 kJ (41 kcal)
Carbohydrates (sum)	5.8 g	9.6 g
Sugar	3.2 g	4.7 g
Dietary fiber	2.5 g	2.8 g
Fat	0.1 g	0.24 g
Proteins	1.28 g	0.93 g

in Haiti and abroad. This analysis is subjected to serve as a contribution to particularly increase awareness of Haitian cuisine through the understanding of *pikliz* as related to its countless health benefits and social-cultural impact. *Pikliz*, the symbol of Haitian culture and cuisine.

Authors' contributions

JLJ led the research, drafted, and edited the manuscript. RS, DS, KLJ, and NS served as co-team leader and editors. Photographs of homemade *pikliz* were produced by MLT. All authors, contributed as member of the research team, read, and approved the manuscript.

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Declarations

Competing interests

The authors declare that they have no competing interests.

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