Received: 15 January 2016 | Revised: 12 September 2016 | Accepted: 20 October 2016

DOI 10.1002/ajpa.23129

RESEARCH ARTICLE

WILEY American Journal of PHYSICAL ANTHROPOLOGY

Dietary habits in New France during the 17th and 18th centuries: An isotopic perspective

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Funding information
This research was supported by grants from the Social Sciences and Humanities Research Council (#766-2010-0638), the Fonds de Recherche du Québec-Société et Culture (#141240), and fundings from Fonds France Canada pour la Recherche (2012–2014: I. Ribot and A.-M. Grimoud) and from Groupe de recherche AS2 ArchéoScience/ArchéoSociale (FQRSC).

Abstract

Objective: Little attention has been given, so far, to the early colonial diet in New France from an isotopic perspective. Historical records that compare France to New France suggest a shift toward a more diverse diet, including a higher protein intake due to an improvement in living conditions in the New World, despite the retention of ancestral dietary habits. This hypothesis will be explored here.

Materials and methods: Stable carbon (organic and mineral) and nitrogen isotopes were measured on 43 individuals from Notre Dame cemetery (first Catholic parish church cemetery in Montreal, 1683–1803) as well as 13 French compatriots from La Rochelle, France (Protestant Hospital Cemetery, 1765–1792). Intragroup variation (age at death, sex, and/or burial location) was investigated and compared to compiled data from various northeastern North American sites ($N = 99$).

Results: The Notre Dame sample means are as follows: −19.6‰ versus VPDB for $\delta^{13}C_{collagen}$, −12.22‰ versus VPDB for $\delta^{13}C_{carbonate}$, and 11.5‰ versus AIR for $\delta^{15}N$. They are significantly lower than both La Rochelle (−18.4‰, −11.67‰, and 12.7‰, respectively, $p \leq .005$) and the northeastern North American groups used for this comparison ($p = .000$).

Discussion: The isotopic values obtained from Notre Dame cemetery suggest that the diet was mainly based on C_3 resources with limited C_4 resources. Although different from all comparable contemporary sites, colonial Montreal's diet remains most similar to La Rochelle, France. This study agrees with historians who have suggested that French dietary traditions seem to have been retained among the early colonial inhabitants of Montreal.

KEYWORDS
apatite, collagen, maize, Montreal, stable isotopes

1 | INTRODUCTION

Diet is an essential behavior associated with both culturally inherited practices and environmental conditions. During the colonization of northeastern America since the 17th century, European migrants were confronted with a new habitat (climate and resources) and new groups with cultural traditions (subsistence, choice, and preparation of food) that were very different from the Old World. In New France, despite frequent periods of food shortages (due to e.g., long, harsh winters, shorter plant growing seasons, and delays in the arrival of imported food supplies by boat), local historians assume that the diet of the colonists was generally better than their French counterparts (Audet, 2001; Fournier, 2004). However, this remains a historical hypothesis that has never been tested bioarchaeologically. Here we explore this question using stable isotope geochemistry. For this purpose, we focus on a population sample from the cemetery of the first parish church in Montreal (Notre Dame, 1683–1803), dated mainly to the French period of colonization (the city was founded in 1642), although overlapping the British Conquest (the city surrendered in 1760). The Notre Dame cemetery was chosen because it represents one of the earliest urban colonial populations in North America. It therefore allows the exploration of the "earliest stages" of Europeans' adaptation to the New World habitat, in contrast to previous paleodietary work that focused on later periods of occupation and on Quebec city in particular (Morland, 2009;

Morland & Ribot, 2009, 2010; Ribot, Morland, & Desrosiers, in press; Ribot et al., 2012; Toupin, 2015).

1.1 Historical records on diet in France and in colonial Montreal

Historical records indicate that colonists in New France were, in part, attracted by the opportunity to hunt and fish freely across the vast territories of the New World (Boucher, 1664; Lanctot, 1942). At that time, in France, only the *Seigneur* and his representatives could hunt on the property. Very few peasants owned the land they cultivated and until the mid-17th century poaching could ultimately lead to death (Salvadori, 1996). Therefore, the diet of most of the French peasants consisted principally of bread made from various crops (wheat, spelt, rye, barley, and oats during crises) accompanied by soups and stews (herbs, vegetables, and beans), with little pork (lard), beef, and/or fish added (Quellier, 2007). Postmedieval demographic expansion put pressure on husbandry and crop production. A few years of bad crops sufficed to raise the price of bread and generate famines on a national scale. Therefore, living conditions in the 17th to 18th century France were generally described as poor, as citizens suffered from hunger and lacked animal protein and/or suffered from other dietary deficiencies (Montanari, 1995; Quellier, 2007).

In New France, colonists were offered more opportunities than in feudal France. In fact, in addition to the right to hunt and fish, every man between the ages of 16 and 60 years had to possess a firearm for defense (Bouchard, 1999). However, it seems that, except for birds (wild pigeons were overhunted and went extinct), wild game was not consumed frequently. Studies of faunal remains show low frequencies of wild species (moose, beaver, groundhog, and bear) (Desloges & Lafrance, 1994; St-Germain, 2015), which may be explained by various factors. For example, farming and clearing the land were time consuming, thus hunting might have been a supplementary activity when people had time to partake therein (Audet, 2001; Desloges & Lafrance, 1994). Also, as soon as Montreal's inhabitants started raising livestock, they depended more on domestic (mainly pork and beef) rather than wild species (Dechêne, 1974; Desloges, 2009; Fournier, 2004).

A detailed account of eating habits in New France is provided in the journal of Pehr Kalm, a Swedish explorer-naturalist, who travelled to Canada in 1749 (reedited by Rousseau & Béthune, 1977). Housed by middle-class inhabitants, he took notes on what was served during the three daily meals. Breakfast consisted of pieces of bread soaked in homemade *eau de vie* (for men) or in chocolate (for women). For lunch, a soup of broth and bread was served, followed by roasted or boiled meat and vegetables, with dairy products for dessert. Dinner consisted of roasted meat or grilled fish, supplemented with salad and vegetables. Water was the most common drink (Montreal had many public wells), followed by cow's milk (fresh, boiled, or curdled). Spruce beer was produced locally (Boucher, 1664). Wine and spirits (brandy, and later rum) were imported, and due to their high cost mainly consumed by the wealthiest.

Before the 1740s when imports from the Caribbean (e.g., sugar cane) increased, sugar intake in the colony was quite low. Sugar was mainly extracted from maple trees (maple syrup) and, also, from maize stems (Audet, 2001; Desloges, 2009; Fournier, 2004; Rousseau & Béthune, 1977).

It is assumed that fish was frequently consumed in the colony due to religious practices within the Catholic immigrant population. In fact, in 1625, following the arrival of the Jesuits, a Royal Edict restricted the immigration to New France to only Catholics. Consequently, meat consumption was proscribed during almost 155 days throughout the year, because Catholics were not allowed to eat meat on Fridays, Saturdays, Lent and at various events (Fournier, 2004). Moreover, historical records and faunal remains indicate vast consumption of fish species. Eel, catfish, sturgeon, longnose gar, redhorses, cod, and crayfish were fished from the many rivers surrounding the city, or imported occasionally (Desloges & Lafrance, 1994; Séguin, 1973; St-Germain, 2015). Pehr Kalm related, with an amused tone, that colonists ate beaver meat on Saturdays, as this animal was considered as a fish, because of its semiaquatic habitat.

Among many of the plants used by the Aboriginal people, like maize, beans, squash, melons, and pumpkins, historians consider that mainly melons and pumpkins were integrated into the colonial diet (Desloges, 2009; Fournier, 2004). In contrast, maize consumption, although quite popular in New England and during the first years of the colony (before 1680s), was not widely adopted throughout New France. This might be related to the fact that it produces flat bread. Therefore, crops of other grains (mainly wheat) known to produce raised bread were preferred although maize could be mixed in small quantity in periods of shortages (Dechêne, 1974). However, Kalm mentions that both the "coureurs des bois" (French Canadian woodsmen) and the missionaries carried bags of maize flour during their long journeys for fur trading or conversion, respectively. This flour had the advantage of being light and filling, and it could easily be mixed with water, berries or animal fat to make a hearty meal, called *sagamité* by the Iroquoians.

To sum up, although the diet in New France is thought to be quite similar to the French tradition (during the 17th and 18th centuries), it probably evolved according to a wide range of factors: climate, habitat, economy, group interaction, social status and profession. In comparison to France, the diet in New France is assumed to be more diverse as colonists adopted various new food traditions from the Aboriginals like melons, pumpkins, maize, maple syrup, and spruce beer. Dietary consumption in New France is also thought to include more protein than in the Old World. In fact, meat from domestic livestock and fish were rather abundant, and the consumption of the latter in large quantities reflected dominant Catholic practices. At that time, Montreal probably reflected a continuum of French traditions, as well as a mix of practices due to interaction with the Aboriginals—the city was founded as a Catholic mission post and it rapidly became, due to its geographic position, an important gateway to the West for fur trading.

1.2 | Diet reconstruction with stable isotopes

Stable isotopes have proven to be an excellent tool in complementing historical sources in reconstructing past dietary contexts (i.e., Katzenberg, 2008; Lee-Thorp, 2008). Vogel and Van der Merwe's (1977) publication pioneered their use in North American bioarchaeology, as they addressed the question of the introduction of maize using $\delta^{13}C$

collagen analysis. Since then, carbon stable isotopes have become a key tool at the center of many paleonutritional studies.

The integration of carbon within the terrestrial biomass occurs mainly following two major photosynthesis pathways. First, C_3 (Calvin Cycle) is the most common, employed by virtually every plant, shrub, and tree in moderate climates. It strongly discriminates between ^{13}C and ^{12}C, producing low $\delta^{13}C$ values (around −26.5‰ vs. VPDB). Second, C_4 (Hatch-Slack) is mostly associated with tropical latitudes and grasses, including certain plants like maize and sugar cane. This pathway, in contrast, results in higher $\delta^{13}C$ values (around −12.5‰ vs. VPDB) (Smith & Epstein, 1971). Aquatic and marine organisms have $\delta^{13}C$ values reflecting the diverse sources of carbon in their diet, which lead to intermediate values between C_3 and C_4 plants. The $\delta^{13}C$ is then transmitted, almost unchanged (a small increase of 1‰ has been reported by Schoeninger (1985)), in proportion with food intake, throughout the trophic chain, allowing dietary reconstructions of C_3 versus C_4 plant consumption to be made.

As early as 1984, Krueger and Sullivan exposed an interpretative bias of the $\delta^{13}C$ obtained from bulk analysis of collagen toward the protein intake of the diet, and advocated for a combined use of $\delta^{13}C$ from both organic and mineral portions of bones (Krueger & Sullivan, 1984). Kellner and Schoeninger (2007) calculated, based on multiple datasets obtained from controlled feeding studies, that $\delta^{13}C$ collagen is correlated to the $\delta^{13}C$ of the whole diet ($r^2 = 0.54$) and to the protein intake ($r^2 = 0.65$). Even more, the $\delta^{13}C$ obtained from bone hydroxyapatite carbonate is very well correlated to the $\delta^{13}C$ of the whole diet ($r^2 = 0.97$). Subsequently, they developed a linear model based on the $\delta^{13}C$ obtained from both collagen and carbonate. The model was later improved by including $\delta^{15}N$ data (Froehle, Kellner, & Schoeninger, 2012). The interest of the nitrogen isotopic value resides in its enrichment of 3–5‰ between each trophic level, leading to higher $\delta^{15}N$ in carnivores versus herbivores, and marine versus terrestrial resources—marine environment reflecting longer food chains (Minagawa & Wada, 1984; Schoeninger & DeNiro, 1984; Schoeninger, DeNiro, & Tauber, 1983). The multivariate model produced by Froehle et al. (2012) allows for the identification of the source of energy (C_3 or C_4) and protein intake (C_3, C_4 or marine) of a diet. Therefore, an archaeological specimen of unknown diet can be identified within a framework of known isotopic variation and can be related to five clusters representing different dietary combinations.

1.3 | Objectives

Based on these recent advances in stable isotope interpretation tools of both carbon (organic and inorganic origins) and nitrogen, the present study will focus on a sample of individuals from the Notre Dame cemetery in Montreal and will address the following questions:

1. What was the diet of the European immigrants in New France, and more particularly within the cemetery; how did it vary according to age, sex, burial placement and chronology?
2. And, to what extent did the colonization processes impact the diet of the European immigrants in New France? The latter question in particular will allow us to explore if there was any dietary improvements in New France as compared to France, as suggested by previous historical data.

To answer these questions, Notre Dame individuals were compared with French citizens dated to a similar period and originating from La Rochelle, a key port site from which many immigrants left for the New World.

Finally, their dietary adaptive response to a novel local resource such as maize will be further addressed by comparing this dataset with neighboring North American groups such as Aboriginal people and New England colonists.

2 | MATERIAL

Isotopic analyses were carried out on bone samples from two archaeological sites, one Canadian (Notre Dame cemetery, Montreal, 1683–1803) ($N = 43$) and one French (Protestant hospital's cemetery, La Rochelle, France, 1765–1792) ($N = 13$) (Figure 1a,b).

Notre Dame was the first parish cemetery to be associated with a Catholic church, built within the city in 1682 (Arkéos, 2008). Death registries indicate that the first interment occurred, within the church walls (or *ad sanctos* or close to the Saints), in 1683. The first interment in the graveyard occurred in 1691. Therefore Notre Dame cemetery started to be used 41 years after the foundation of the city in 1642 and just after the main wave of French migration that ended in the 1680s. Later, in 1733, the burial ground expanded southward in response to the growing population. It was closed in 1796, although inhumation continued *ad sanctos* until 1803 (Arkéos, 2008). Thus, the burials can be associated with three locations: under the church floor or CF (between 1683 and 1803); next to the church or NC (earliest portion of the cemetery used from 1691 but probably reused later up to 1796); and a southern portion or SP (later area of the cemetery used from 1733 up to 1796) (Figure 2). *Ad sanctos* inhumation was reserved to privileged individuals such as clergymen and notables, while the Catholic parishioners were buried in the outdoor cemetery (Olivier-Lloyd, 2008).

Unfortunately, because of various factors, notably the salvage excavation context and the urban setting (high burial density under a busy street), a rather fragmented and mingled bone collection was available for study. Out of approximately 200 burials excavated in 2003 and 2004, only about 25% were suitable for the current study (Vigeant 2012). Sex was estimated using measurements on both hip bones (Murail, Bruzek, Houët, & Cunha, 2005) and second metacarpals (Lazenby, 1998, 2002). Age at death for adults grouped in two categories (under or over 40 years of age) was evaluated using degenerative processes such as: the pubic symphysis (Brooks & Suchey, 1990), the auricular surface (Schmitt, 2005) and the sternal end of the fourth rib (Hartnett, 2010). The sample under study consisted therefore of 43 individuals: 8 preadults aged from 12 to 20 years (all of unknown sex), 19 mature adults aged from 21 to 40 years (8 females, 5 males, 6 of unknown sex); 11 individuals aged over 41 years (3 females, 8 males); and five individuals of unknown age (2 males, 3 of unknown sex) (Appendix).

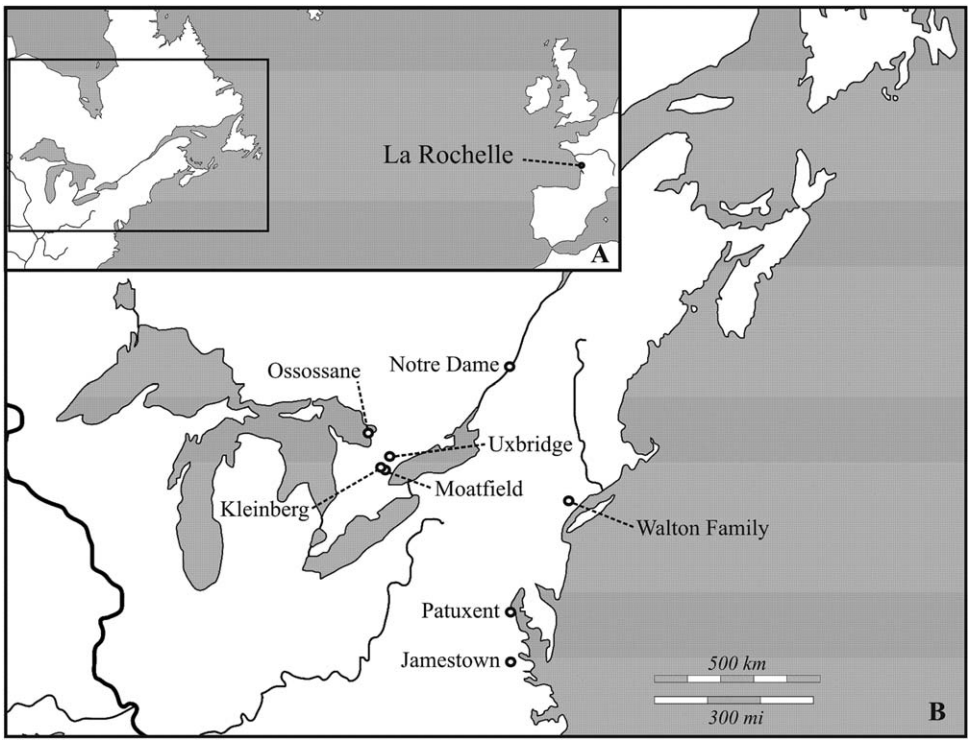

FIGURE 1 Localization of (1) Notre Dame's cemetery and comparative sites: (2) La Rochelle, France (1765–1792), (3) Great Lakes area Aboriginal peoples: Moatfield (1300), Uxbridge (1360), Kleinberg (1600), and Ossossane (1636), and (4) 17th century sites: Jamestown (1609–1675) and Patuxent (1658–1680), and (5) 18th and 19th centuries: Walton Family (1750–1830) New England populations

In addition, a small sample of thirteen adults (rib fragments) originating from the hospital cemetery of La Rochelle in the western region of Poitou-Charentes, France, was analyzed. Located in the eastern part of the city and within its walls, the cemetery of this hospice, built in 1765, was not only used by the poor and sick but also used by the Protestant community at large until its closure in 1792 (Souquet-Leroy & Buquet-Marcon, 2015). According to preliminary osteological analysis, La Rochelle's sample consists of six females, five males, and two specimens of unknown sex (IR 2011, Souquet-Leroy, personal communication) (Appendix).

A compiled isotopic dataset ($N = 99$) was also used for comparison (Figure 1b). These data correspond to two main groups from northeastern North America: Europeans and Aboriginals. The European population includes individuals originating from three colonial sites located in New England and dated between the 17th and 19th centuries (Jamestown Island, Virginia [1609–1675], Patuxent Point, Maryland [1658-mid-to-late 1680s]: Ubelaker & Owsley (2003), and the Walton Family, Connecticut [1750–1830]: France, Owsley, & Hayek, (2013)). The Aboriginal individuals come from four sites located around the Great Lakes and date between the 14th and 17th centuries (Moatfield [ca. 1300]: Van der Merwe, Williamson, Pfeiffer, Thomas, & Oakberg Allegretto (2003); Uxbridge [1490 ± 80] and Ossossane [1636]: Harrison & Katzenberg (2003); Kleinberg [1600]: Schwarcz, Melbye, Katzenberg, & Knyf (1985)). The latter is subdivided into two subgroups, the Pre-Contact sites (before 1500: Moatfield and Uxbridge) and the Contact period sites (after 1600: Kleinberg and Ossossane).

3 | METHODS

All the collected bone samples (approximately 1 g of nonpathological jaw and/or rib fragments per specimen) were prepared and analyzed at the Stable Isotopes Laboratory of the Geotop research center (Université du Québec à Montréal). Prior to any treatment, they were manually cleaned, then immersed in an ultrasonic bath until the water was clear, in order to avoid soil contamination. The bones were then ground to a fine powder with an agate pestle and mortar. Collagen was extracted following procedures adapted from Sealy & Van der Merwe (1986) as follows: 500 mg of bone was demineralized in 1% hydrochloric acid (HCl) until the mineral fraction was dissolved (when the sample stopped producing CO_2); the residue was then rinsed three times in deionized water until pH stabilized; organic contaminants were removed using a solution of 0.5 M sodium hydroxide (NaOH), for 20 hr with the solution being renewed every 2 hr; and finally, the samples were rinsed to neutrality and freeze-dried. Carbon and nitrogen concentrations were measured using a Carlo Erba NC 2500 elemental analyzer to determine the molar C:N and the weight %N, to provide information on collagen preservation (Ambrose, 1990; Bocherens et al., 1997; DeNiro, 1985). Carbon and nitrogen isotopic compositions were measured using an Isoprime 100™ isotope ratio mass spectrometer coupled to an Elementar Vario MicroCube™ in continuous flow mode. The reported analytical uncertainty is ±0.1‰ for $\delta^{13}C$ and ±0.2‰ for $\delta^{15}N$.

Bone apatite carbonate was extracted as follows: The organic matter was removed by soaking an aliquot of the untreated sample in a 2%

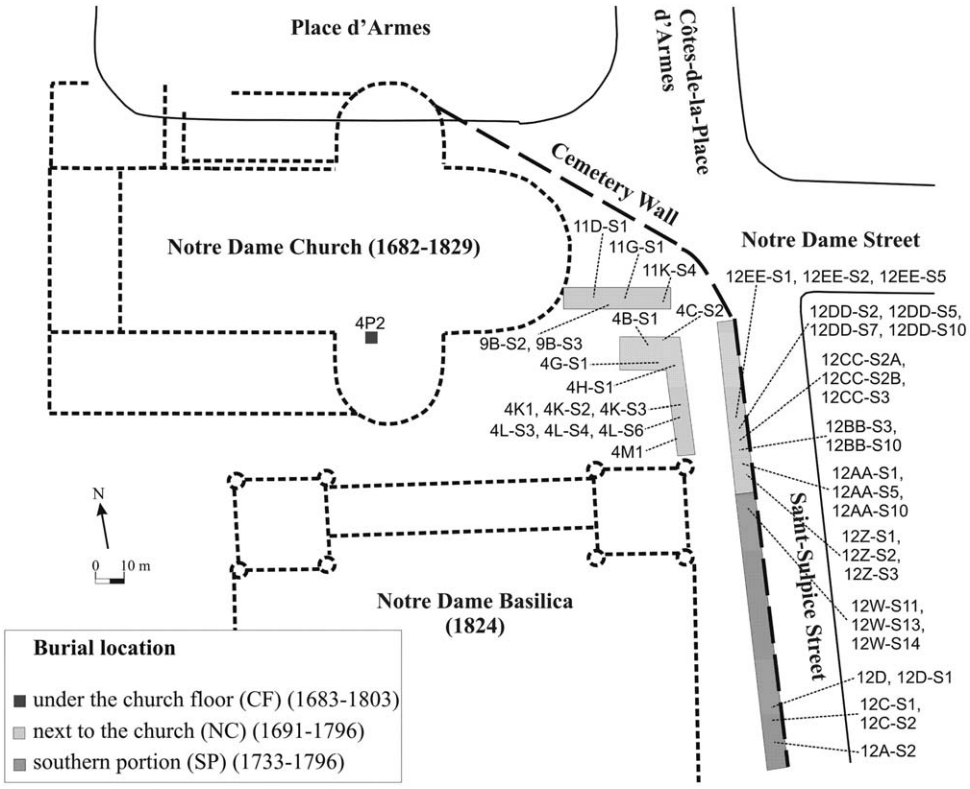

FIGURE 2 Detail of the Notre Dame excavations shows the distribution of the burial in the cemetery (plan modified from Arkéos (2008))

sodium hypochlorite (NaOCl; bleach) solution for 24 hr; it was then rinsed to neutrality and freeze-dried. An acetic acid treatment was applied as suggested in studies on bone carbonate preparation method (Garvie-Lok, Varney, & Katzenberg, 2004; Koch, Tuross, & Fogel, 1997; Metcalfe, Longstaffe, & White, 2009). However, as aberrant $\delta^{18}O$ were obtained (as high as +111‰ vs. VSMOW) the carbonate was reextracted from the original samples without this acetic acid step. For each sample, 1.20 mg of bone powder was analyzed for $\delta^{13}C$ of carbonates using a Micromass Isoprime™ isotopic ratio mass spectrometer in dual inlet mode and coupled to a Multicarb™ system. In this case, the analytical uncertainty is ±0.05‰.

Finally, in order to explore the variation of the data on both intra- and inter-group levels, univariate statistics and graphs were performed with SPSS version 22 and Excel 2011. Depending on the normality of the variables (as determined by a Wilks–Shapiro test), Student's *t* test, Mann–Whitney *U* test, or Kruskal–Wallis were used for mean comparisons.

4 | RESULTS

All isotopic results[1] are reported in detail in Appendix. They are presented below, in two sections, focusing first on Notre Dame's intragroup analysis and then expanding to intergroup comparisons. Since there is a possibility of post depositional alterations of the original isotopic signal, only specimens with well-preserved collagen (i.e., presenting a molar C:N ratio between 2.8 and 3.6 and a weight %N yield of ~11–16%) were considered here (Ambrose, 1990; DeNiro, 1985). This procedure also enables us to confirm the preservation of the mineral fraction, as many studies have noted that well-preserved collagen is often associated with unaffected minerals, either by recrystallization or by alteration (Nelson, DeNiro, Schoeninger, De Paolo, & Hare, 1986; Tütken, Vennemannc, & Pfretzschner, 2008). Therefore, two specimens (12AA-S5 and 12C-S1) were excluded from the results.

4.1 | The 17th to 18th century Notre Dame sample

A summary of the descriptive statistics obtained for the Notre Dame cemetery is found in Table 1. For the whole sample, the $\delta^{13}C_{collagen}$ and $\delta^{13}C_{carbonate}$ data are grouped around the mean with a standard deviation of only 0.3–0.6‰, respectively. At first, the mean (−18.4‰) was quite different from the median of $\delta^{13}C_{collagen}$ (−19.6‰), because of the influence of a ^{13}C enriched value obtained from a mature male (12Z-S3: $\delta^{13}C_{collagen} = -16.7$‰) (Figure 3). This specimen (particularly enriched in ^{13}C) was removed from the calculation of the mean values for the Notre Dame sample, since it is considered as an outlier (his isotopic composition will be discussed in depth later). Otherwise, the values for $\delta^{13}C_{collagen}$ vary from −20.5 to −18.9‰. The mean for $\delta^{13}C_{carbonate}$ is −12.2‰, with values ranging from −13.8 to −11.4‰. In contrast, $\delta^{15}N$ values (mean: 11.5‰) range from 9.7 to 14.4‰ and show more variation than $\delta^{13}C_{collagen}$ and $\delta^{13}C_{carbonate}$ values.

When analyzing the variation according to sex, no significant differences are found for both $\delta^{13}C_{carbonate}$ ($p = .983$, *t* test) and $\delta^{13}C_{collagen}$ ($p = .298$, *U* test). The mean differences between males and females are positioned within the analytical uncertainty (Table 1). For the $\delta^{15}N$,

TABLE 1 Isotope results for Notre Dame's cemetery according to sex, age at death and burial localization[a]

		$\delta^{13}C_{carbonate}$ ‰ versus VPDB			$\delta^{13}C_{collagen}$ ‰ versus VPDB			$\delta^{15}N$ ‰ versus AIR		
	N	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
By sex										
Female	10	−12.25	0.51	−13.02; −11.43	−19.5	0.3	−20.2; −19.2	11.8	1.2	10.6; 14.4
Male	13	−12.24	0.53	−13.26; −11.49	−19.7	0.2	−20.1; −19.1	11.4	1.1	9.8; 13.0
By age groups (in years)										
12–20	8	−12.35	0.77	−13.37; −11.36	−19.9	0.2	−20.5; −19.8	10.9	0.9	9.7; 12.7
21–40	19	−12.03	0.47	−13.02; −11.38	−19.5	0.3	−20.2; −18.9	11.9	1.1	10.5; 14.4
>41	8	−12.54	0.54	−13.26; −11.49	−19.5	0.2	−19.7; −19.1	11.5	1.0	10.0; 12.6
Localization in the cemetery[b]										
CF (1683–1803)	1	−13.84			−19.8			12.2		
NC (1691–1796)	33	−12.18	0.60	−13.37; −11.36	−19.6	0.3	−20.5; −18.9	11.6	1.1	9.7; 14.4
SP (1733–1796)	7	−12.30	0.47	−13.02; −11.74	−19.7	0.3	−20.1; −19.2	10.9	1.0	9.8; 12.6
Total	41	−12.22	0.62	−13.84; −11.36	−19.6	0.3	−20.5; −18.9	11.5	1.1	9.7; 14.4

[a]Outlier 12Z-S3 have been excluded from the comparison. [b]According to three coded areas: CF = burial found under the church floor; NC = burials found in the cemetery portion next to the church; SP = burials found in the southern portion of the cemetery.

although sex differences are still not statistically significant ($p = .335$, *t* test), variation among females appears slightly higher than among males.

Differences between age groups were tested by pairs (7 *t* tests and 2 nonparametric *U* tests were performed: $\delta^{13}C_{collagen}$ from preadults as a nonparametric distribution). For $\delta^{13}C_{carbonate}$, they are statistically significant ($p = .02$) between the two older groups, with adults over 41 years of age showing lower $\delta^{13}C$ values than mature adults (mean difference: 0.51‰) (Table 1). Conversely, the preadults show differences in $\delta^{13}C_{collagen}$ with both groups ($p < .003$, Mann–Whitney). Enrichment in ^{13}C is observed between the preadults (from −20.5 to −19.8‰) and the less depleted values obtained from the mature (from −20.2 to −18.9‰) and oldest (from −19.7 to −19.1‰) adults. No statistical difference is noted between these last two groups. For $\delta^{15}N$, a slight, but still statistically significant ($p = .031$, *t* test), enrichment is observed between the preadults (from 9.7 to 12.7‰) and the mature adults (from 10.5 to 14.4‰). In particular, two mature adults show the highest $\delta^{15}N$: a female (9B1-S3: 14.4‰) and an individual of unknown sex (9B1-S2: 13.9‰). In comparison to the highest preadult value (4L-S6: 12.7‰), these adults are clearly enriched in ^{15}N by more than the uncertainty value (±1‰ as measured by DeNiro and Schoeninger (1983)).

Only two broad areas within the cemetery were compared (NC and SP), as only one individual from under the church floor was available. Nevertheless, it is interesting to note that this single individual shows the lowest $\delta^{13}C_{carbonate}$ value (−13.84‰) and a relatively high

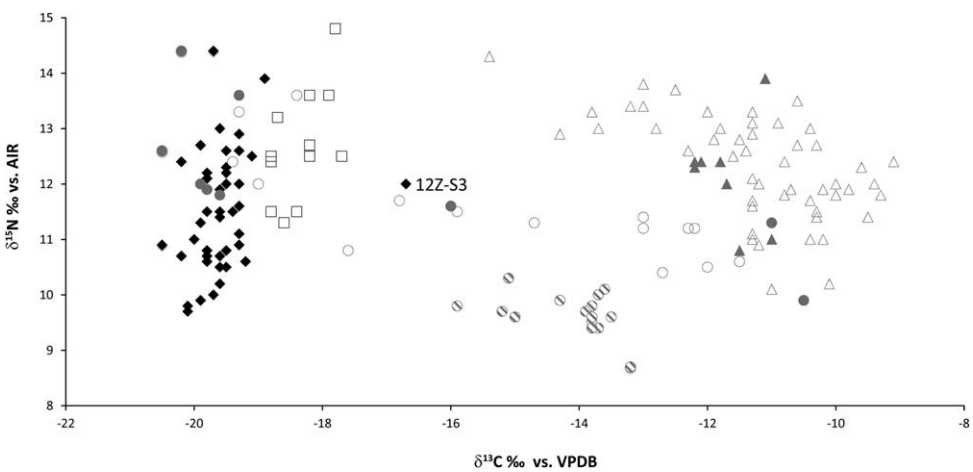

FIGURE 3 Graph showing the $\delta^{13}C_{collagen}$ plotted against the $\delta^{15}N$ for Notre Dame's sample (black diamonds) and other comparative groups (La Rochelle: hollow black squares; Jamestown Island: grey circles; Patuxent Point: hollow grey circles; Walton Family: hatched grey circles; Pre-Contact Aboriginal sites: hollow grey triangles; Contact Aboriginal sites: grey triangles)

TABLE 2 Isotope results for La Rochelle' hospital cemetery, France, according to sex

		$\delta^{13}C_{carbonate}$ ‰ versus VPDB			$\delta^{13}C_{collagen}$ ‰ versus VPDB			$\delta^{15}N$ ‰ versus AIR		
	N	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
By sex										
Female	6	−11.63	0.44	−12.15; −10.93	−18.5	0.4	−18.8; −17.8	12.8	1.1	11.5; 14.8
Male	5	−11.64	0.19	−11.88; −11.41	−18.3	0.4	−18.8; −17.9	12.5	1.1	11.3; 13.6
Total[a]	13	−11.67	0.41	−12.47; −10.93	−18.4	0.4	−18.8; −17.7	12.7	1.0	11.3; 14.8

[a]Two individuals of unidentified sex have been added to the total.

$\delta^{15}N$ (12.2‰) in comparison with the others (Table 1). When comparing individuals found in the area next to the church (NC) with those found in the southern portion of the cemetery (SP), their means are not statistically different for all isotopic values. However, the range of $\delta^{15}N$ values measured within the individuals buried in the southern portion of the cemetery is slightly narrower (from 9.8 to 12.6‰) than that obtained for the individuals buried next to the church (from 9.7 to 14.4‰).

4.2 | Comparison of New France with France

Results for the La Rochelle hospital cemetery are presented in Table 2. For this French sample, sex differences are not statistically significant (all isotopes: $.641 < p < .976$), although, for $\delta^{15}N$, La Rochelle females vary slightly more than the males.

Comparing the data of Notre Dame with that of La Rochelle, all results show differences that are highly significant ($p \leq .005$). For the French sample, all the isotope values are generally higher than Notre Dame (excluding the outlier 12Z-S3), although the range of variation is rather low, probably because of the small sample size (Figure 3). Mean differences are also low for $\delta^{13}C_{carbonate}$ (0.55‰), but they are relatively high (+1.2‰) for both $\delta^{13}C_{collagen}$ and $\delta^{15}N$.

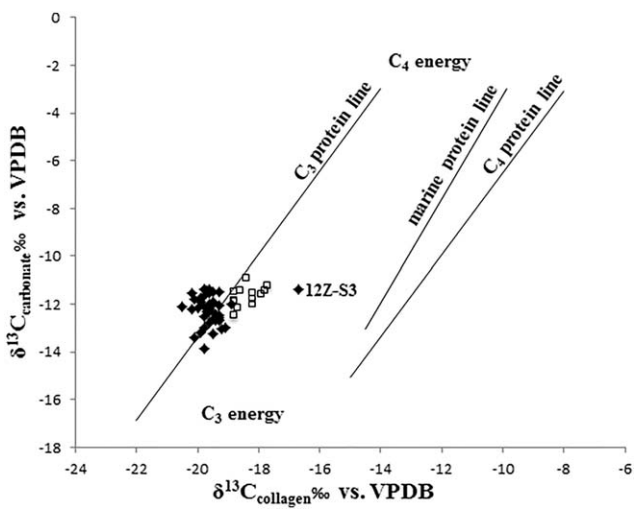

FIGURE 4 Graph showing the $\delta^{13}C_{collagen}$ plotted against the $\delta^{13}C_{carbonate}$ for Notre Dame's Cemetery (black diamonds) and La Rochelle's, France, sample (hollow squares), according to the linear model of Kellner & Schoeninger (2007)

According to the linear model of Kellner and Schoeninger (2007) (Figure 4), both populations cluster next to the C_3 protein regression line, although the French individuals from the old continent tend to shift slightly more toward the marine protein line. One of Notre Dame specimens (12Z-S3) is clearly marginal, as his enrichment in ^{13}C also indicates a diet toward a higher intake of marine or C_4 proteins.

4.3 | Further comparisons with various northeast North American groups

Aboriginal American groups have the highest values, especially for $\delta^{13}C$ ($\delta^{13}C_{carbonate}$: from −8.0 to −1.7‰; $\delta^{13}C_{collagen}$: from −15.4 to −9.1‰) (Table 3). In contrast, New England populations are extremely variable for both $\delta^{13}C_{carbonate}$ (from −12.5 to −5.1‰) and $\delta^{13}C_{collagen}$ (from −20.5 to −10.5‰). In particular, the Walton Family sample shows the highest $\delta^{13}C$ means ($\delta^{13}C_{carbonate}$: −8.98‰; $\delta^{13}C_{collagen}$: −14.1‰) and the lowest $\delta^{15}N$ mean value (9.7‰).

The comparison of the seven northeastern North American groups with the Notre Dame sample shows highly significant differences ($p = .000$, Kruskal–Wallis) (Figure 3). Mean differences are highest with one Pre-Contact site (Uxbridge, $\delta^{13}C_{collagen}$: +8.7‰) and lowest with one colonial site (Patuxtent Point, identical $\delta^{15}N$). Overall, Notre Dame's sample presents the lowest $\delta^{13}C$ values for both $\delta^{13}C_{carbonate}$ and $\delta^{13}C_{collagen}$ (Table 1). However, the range of variation overlaps the highly variable groups of 17th century New England (Jamestown Island and Patuxent Point). A similar trend is observed for $\delta^{15}N$, as Notre Dame sample has the lowest values (9.7‰), but still represents a relatively high $\delta^{15}N$ value (14.4‰), similar to the colonial Jamestown Island site.

Figure 5 further compares Notre Dame with contemporary northeastern North American and La Rochelle groups, using the multivariate model developed by Froehle et al. (2012). First, according to the "carbon function," Montreal's diet appears clearly defined. Its energy component is provided by at least 70% or more (up to 100%) by C_3 resources, with less C_4 plant intake (between 30% and 0%). La Rochelle's diet is quite similar, although it tends toward a greater consumption of C_4 resources (30%). Notre Dame's sample is also well differentiated from the Aboriginal sample cluster at the other end of the variation, reflecting a diet mostly made of C_4 plants (70%). Positioned between these two extremes, New England colonial sites tend to exhibit a diet mostly composed of C_4 plants (70%), but with a highly

TABLE 3 Isotope descriptive data for the compiled sources used for comparison

		$\delta^{13}C_{carbonate}$ ‰ versus VPDB			$\delta^{13}C_{collagen}$ ‰ versus VPDB			$\delta^{15}N$ ‰ versus AIR		
Sites and dates (A.D.)	***N***	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**	**Mean**	**SD**	**Range**
New England's colonial sites										
Jamestown 1609–1675[a]	9	−10.29	2.40	−12.5; −5.1	−17.4	4.0	−20.5; −10.5	12.1	1.3	9.9; 14.4
Patuxent, 1658–1680[a]	15	−9.05	1.18	−10.6; −7.3	−15.2	3.0	−19.4; −11.5	11.5	0.9	10.4; 13.6
Walton, 1750–1830[b]	16	−8.98	0.72	−10.0; −7.3	−14.1	0.8	−15.9; −13.2	9.7	0.4	8.7; 10.3
Great Lakes' Aboriginals sites: Pre-Contact period										
Moatfield, 1300[c]	42	−4.20	1.57	−8.0; −1.7	−11.3	0.4	−15.4; −9.1	12.6	0.9	11; 15.5
Uxbridge, 1490[d]	9	−4.86	0.46	−5.4; −4.1	−10.8	0.5	−11.3; −10.1	11.1	0.7	10.1; 12
Great Lakes' Aboriginal sites: Contact period										
Kleinberg, 1600[e]	3	−5.43	0.06	−5.5; −5.4	−12.0	0.3	−12.2; −11.7	12.2	0.2	12; 12.4
Ossossane, 1636[d]	5	−5.08	0.66	−5.9; −4.1	−11.5	0.5	−12.1; −11.0	12.1	1.3	10.8; 13.9

[a]Ubelaker and Owsley (2003). [b]France et al. (2013). [c]Van der Merwe et al. (2003). [d]Harrison and Katzenberg (2003). [e]Schwarcz et al. (1985).

variable intake in C_3 resources (30–100%), especially among the earliest sites (Jamestown Island and Patuxent Point). Second, according to the "nitrogen function," Notre Dame's diet reflects an intake of more than 65% (up to 100%) of C_3 protein. At the other end of the spectrum, the Aboriginal diet is dominated by more than 50% C_4 protein, with a tendency toward marine resources for a few individuals. Between these two clusters, New England colonial sites (except for Walton Family, the most recent one) show extreme variation, as their sources of protein range from more than 50% C_4, to between 65 and 100% C_3 intake.

5 | DISCUSSION

5.1 | Montreal's diet between 1683 and 1803: mainly C_3 and occasionally C_4

Although Notre Dame's sample probably represented only a small portion of the French Catholic community that lived in Montreal between the 17th and 18th century, it provides a preliminary snapshot of an early urban community in New France. The last 43 years (from 1760, over a total of 120 years since 1683) correspond to British rule, which

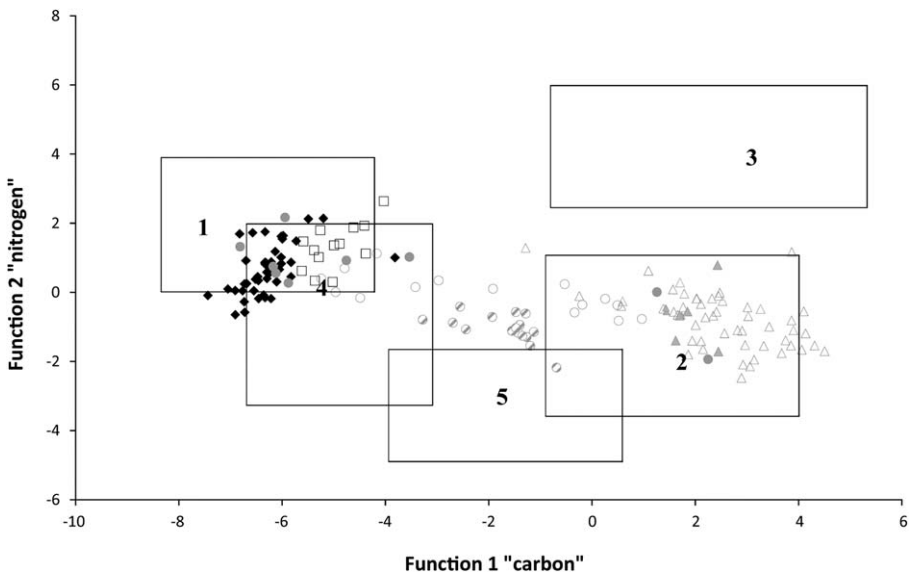

FIGURE 5 Graph showing the two functions of the multivariate model developed by Froehle et al. (2012) with Notre Dame's sample (black diamonds) and other comparative groups (La Rochelle: hollow black squares; Jamestown Island: grey circles; Patuxent Point: hollow grey circles; Walton Family: hatched grey circles; Pre-Contact Aboriginal sites: hollow grey triangles; Contact Aboriginal sites: grey triangles). Numbers correspond to (1) 100% C_3 diet/protein; (2) 30:70 C_3:C_4 diet, >50% C_4 protein; (3) 50:50 C_3:C_4 diet, marine protein; (4) 70:30 C_3:C_4 diet $\geq$ 65% C_3 protein; and (5) 30:70 C_3:C_4 diet $\geq$ 65% C_3 protein

possibly contributed to the introduction of new food items (i.e., tea, sugar cane, molasses, rum, and potatoes) (Desloges, 2009). However, until the 19th century, British immigration was rather low, mostly for military, administrative and mercantile purposes (Linteau, 2007). Therefore, the isotopic data obtained from the Notre Dame cemetery probably reflects mainly the dietary habits in use prior to the British Conquest.

Isotope results suggest that most of the dietary products (i.e., bread, meat, vegetables, and fruits) consumed daily by Notre Dame's individuals originated primarily from C_3 resources with a small proportion of C_4 resources, either local (i.e., maize) or imported (i.e., sugar cane). This observation agrees with what has been proposed by historians: Europeans arriving in New France were still following Old World traditions and they did not eat local plants such as maize on a large scale (Dechêne, 1974; Desloges, 2009; Fournier, 2004). Trappers and missionaries, who often left from Montreal, and as mentioned by Kalm (Rousseau & Béthune, 1977) would have largely adopted the local C_4 food (maize), were not identified in our analysis. The increase of food importation during the 18th century gave Notre Dame's individuals access to nonlocal C_4 food items (i.e., cane sugar and rum).

Nevertheless, the majority of Notre Dame's individuals clearly show a marginal intake of C_4 resources, whatever the origin, since it is impossible to differentiate isotopically local from nonlocal plant foods. For example, although both $\delta^{13}C_{collagen}$ and $\delta^{13}C_{carbonate}$ values of a mature male (12Z-S3) are higher compared to the whole sample range, they probably do not reflect a diet with a high intake of C_4 food. Further interpretations based on linear and multivariate models (Froehle et al., 2012; Kellner & Schoeninger, 2007) suggest, rather, a higher quantity of marine resources in the diet. This is not surprising considering both the ecological and the historical context of 18th century Montreal located on an island at the confluence of various rivers leading to the Atlantic Ocean, with access to large diversity of terrestrial, freshwater and marine resources. It is assumed that individual 12Z-S3 was repeatedly exposed to a marine environment, as he consumed more fish, possibly through his profession (i.e., a sailor?). Except for this case, isotope results on a general population level do not show a significant contribution of fish to Notre Dame's diet. This is in contrast to the historical record and faunal remains that suggest high fish consumption, in line with prevailing Catholic food practices (Desloges & Lafrance, 1994; Séguin, 1973; St-Germain, 2015). This apparent contradiction can however be explained by the chemical nature of aquatic resources, which cannot be clearly distinguished isotopically as reported in Katzenberg (1989) for Great Lakes fish ($\delta^{13}C_{collagen}$: −23.1 to −17.8‰ vs. VPDB and $\delta^{15}N$: 3.6 to 9.9‰ vs. AIR). As a consequence, their presence could not be clearly identified here within the variation, as they provide no specific isotopic signal.

Although the intragroup analysis of Notre Dame cemetery is limited by small sample sizes of certain subgroups, the results agree in large part with historical data. For example, as reported by Kalm (Rousseau & Béthune, 1977), both males and females appeared to have similar diets. Larger sample sizes are however necessary to confirm the observed tendency (although not statistically significant) of a slightly higher $\delta^{15}N$ variation for the 11 females in comparison to the 15 males.

The comparison of isotope values by age group highlights a slight depletion in $^{13}C_{collagen}$ and ^{15}N for the preadults compared to the other age groups. This could be explained, in part, by individual histories as well as the global historical context. In fact, death at a younger age with a poorer diet among preadults possibly reflects a selective mortality phenomenon. Since children in the 18th century were commonly hired as young as 10 years old (i.e., craftsman's apprentice or household servant in Montreal (Lachance, 2004), cabin boy on French boats (Lefrançois, 2007)), Notre Dame's preadults could correspond to this population "category," who possibly experienced harsh living conditions as well as dietary deficiencies. Conversely, the slightly lower $\delta^{13}C_{carbonate}$ of adults aged over 41 years could reflect a better social and professional position that allowed these individuals to maintain a more European-like diet. However, our interpretations have to remain cautious, as a larger sample size could modify the trends observed here.

Further intracemetery comparisons, especially in relation to the three burial areas, may suggest how the diet evolved, although each burial area and individual burial cannot be dated precisely. The most obvious case of social distinction in Notre Dame cemetery is the single burial (4P2) recovered under the church floor or so-called interment *ad sanctos*. Although its isotopic composition cannot unequivocally represent the whole diversity of upper status individuals in old Montreal, two observations can be made: first, this specimen presents the most depleted $\delta^{13}C_{carbonate}$ and $\delta^{13}C_{collagen}$, thus suggesting the retention of a C_3-based diet, probably of a French tradition; and second, its $\delta^{15}N$ is higher than the population mean, possibly suggesting a sign of prestige, since privileged people could afford a higher protein intake through greater meat consumption (Audet, 2001; Dechêne, 1974). Dietary comparisons between the two other burial areas within the cemetery remain difficult to interpret mainly because of the lack of chronological information. Although the tests were not significant, the burial area next to the church presents a higher $\delta^{15}N$ variation than the southern part. However, this could reflect both the larger sample size and a longer chronology for this area of the cemetery in comparison with the southern part (Arkéos, 2008).

5.2 | Montreal versus La Rochelle: slight dietary differences related to habitat

Did European migrants shift toward a more diverse diet, richer in protein, in comparison to their French ancestors as assumed by historians? This question is tentatively addressed here, and the results show the opposite. In comparison to Montreal's sample, La Rochelle's individuals exhibited significantly higher values of $\delta^{13}C$ (collagen and carbonate) and of $\delta^{15}N$. This suggests a greater proportion of marine resources in the diet, as expected from this French community located along the Atlantic coast, as opposed to Montreal located in a fluvial system. These isotopic differences between the two populations therefore reflect differences related primarily to the nature of the habitat rather than to the socioeconomic context. Nevertheless, when compared to other compiled data, both sites display a relatively similar diet that is

mostly based on C_3 resources for energy and protein intake. Unfortunately, the question as to whether French colonists in New France were eating better since resources were more abundant than in Europe could not be answered here unequivocally. In fact, the comparison could focus on only one French site, representing the diet of one 18th century population with a particular habitat. Future transatlantic comparisons involving a greater number of sites and samples could allow further exploration of this issue.

5.3 | New France and the northeastern North American spectrum: retention of French traditions

The nature of a diet is often dictated by both environmental and cultural influences. In the northeast North American context of the 17th and 18th centuries, the colonial diet probably reflects a variety of adaptations to local plants (i.e., maize, pumpkins, melons, and maple sap) and traditions. However, due to interpretative constraints imposed by isotopic fractionation, only maize can be identified among the various other plants introduced by the Aboriginals. It is therefore the main local plant used to address various questions exploring the impact of colonization in the Americas on Europeans immigrants. When the Notre Dame diet is compared with a broad range of northeast North American sites, it clearly reflects a retention of European traditions—mainly C_3-based with marginal C_4 input. The adoption of maize remained, at best, a small-scale phenomenon in colonial Montreal. However, earlier colonial sites further south, such as the 17th century New England cemeteries (Jamestown Island and Patuxent Point) show extreme dietary diversity. The latter was interpreted by Ubelaker and Owsley (2003) as indicative of the transition from a C_3 European-like diet to a C_4 Aboriginal-like diet, therefore reflecting a greater adoption of maize. Furthermore, the isotopic compositions obtained from the more recent 18th to 19th century rural site of Walton Family reinforce this observation: maize, an indigenous plant, was fully adopted into the new colonial farming economy. This comparison highlights dietary differences related to various factors, not only economical but also both historical and ecological ones. In New England colonies, Algonquian groups were still practicing their traditional agriculture as colonists settled. The latter adopted maize as it was better adapted to the soil and climate of this region than wheat (McMahon, 1985). In contrast, when Montreal was founded there were no more Iroquoian groups practicing horticulture in the Saint-Lawrence Valley probably following internal conflicts (Jamieson, 1990). A northern species of wheat also became the dominant crop, as it well fitted to the short growing season and heavy and moist soils of Montreal's Island (Dechêne, 1974). Therefore, the low consumption of maize in the early colonial city could be explained partly by this historical and ecological setting, in addition to food preferences.

6 | CONCLUSION

Isotopic results of bone collagen ($\delta^{13}C$ and $\delta^{15}N$) and carbonate ($\delta^{13}C$) for Notre Dame cemetery appears to broadly agree with historical records (Audet, 2001; Dechêne, 1974; Desloges, 2009; Fournier, 2004; Rousseau & Béthune, 1977; Trudel, 2001). Most of the individuals buried in this Catholic cemetery had a diet that was European-like (or C_3-based), despite the possible integration of some local resources (either C_3 or C_4 plants: i.e., pumpkins, melons, maple syrup, maize, and spruce beer). This cultural retention of French traditions seems to be characteristic of this early colonial period, apart from a few exceptions where maize was adopted (i.e., fur traders and missionaries). Because the cemetery reflects a rather long chronology, dietary habits observed here could also indicate an increase in the consumption of imported goods especially in the late 18th century (i.e., sugar cane and rum).

The hypothesis of a dietary improvement in New France in comparison to the Old World could not be answered here. Although Notre Dame's individuals could have diversified their diet with local resources, there is no clear evidence of higher protein intake in comparison with their French counterparts from La Rochelle. However, comparative analysis was limited here to a coastal site, which is not representative of the whole of France.

Further comparisons of Notre Dame's sample with various northeastern North American sites will enable us to explore the diversity of diet in various colonial contexts. Colonization processes did not seem to have significantly modified the diet of early colonial inhabitants in Montreal. This observation is very different when compared to British Colonists in the American colonies, where the colonial economy integrated indigenous resources such as maize (i.e., Walton Family's site).

Focusing on a unique sample of early colonial Montreal, the present isotopic study is a preliminary comparative analysis that attempts to define dietary habits in New France versus France, and to some extent versus northeastern North America. To further explore the dietary diversity, and possible shifts or retentions, through time and space, French sites reflecting a wide range of habitats will have to be compared with Notre Dame cemetery. Other work in progress on the variation from different French colonial sites (rural vs. urban) and different periods will also help to improve paleodietary comparisons on a transatlantic level.

ACKNOWLEDGMENTS

This research was supported by grants from the Social Sciences and Humanities Research Council (#766-2010-0638), the Fonds de Recherche du Québec-Société et Culture (#141240), and fundings from Fonds France Canada pour la Recherche (2012–2014: I. Ribot and A.-M. Grimoud) and from Groupe de recherche AS2 ArchéoScience/ArchéoSociale (FQRSC). The authors also thank François Bélanger (archaeologist, Ville de Montréal) for allowing analyses on Notre Dame collection, and Isabelle Souquet-Leroy (INRAP, Université de Bordeaux) for allowing analyses on La Rochelle collection. Our thanks also go to various persons, who helped during the isotopic analyses at the Geotop (Agnieszka Adamowicz), and who significantly improved the illustrations (Denny Caron), the English (Otto Graf, Adrian L. Burke, Sandrine Solignac) and the whole manuscript (anonymous reviewers).

NOTES

[1] All isotopic values were expressed in the δ notation and reported in ‰ versus an international standard (VPDB for carbon and AIR for nitrogen) as

$$\delta(^{ij}E)\,(\text{in}\,‰) = \left[\frac{N(^{i}E)_p/N(^{i}E)_p}{N(^{i}E)_{\text{std}}/N(^{i}E)_{\text{std}}}\right] - 1 \quad (1)$$

where $N_p(^iE)$ and $N_p(^jE)$ are the numbers of the two isotopes ^iE and ^jE of the chemical element E in specimen P, and equivalent parameters follow the international measurement standard, "std" (Coplen, 2011). As described in Brand, Coplen, Vogl, Rosner, & Prohaska (2014), we have simplified the notation to δ^iE.

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APPENDIX: Detailed osteological data and isotopic values for Notre Dame and La Rochelle samples.

TABLE A1

Burial	Sex	Age group in years	$\delta^{13}C_{carbonate}$ ‰ versus VPDB	$\delta^{13}C_{collagen}$ ‰ versus VPDB	$\delta^{15}N$ ‰ versus AIR	C:N	%N weight
Notre Dame: *burial found under the church floor (1683–1803)*							
4P2	?	?	−13.84	−19.8	12.2	3.4	16.5
Notre Dame: *burials found in the cemetery portion next to the church (1691–1796)*							
4K-S3	?	12–20	−12.08	−20.5	10.9	3.4	13.6
4L-S3	?	12–20	−12.98	−19.8	11.5	3.4	15
4L-S6	?	12–20	−13.17	−19.9	12.7	3.4	16.4
11G-S1	?	12–20	−13.37	−20.1	9.7	3.3	12.4
11K-S4	?	12–20	−11.61	−19.8	10.6	3.3	16.7
12CC-S2 (A)	?	12–20	−11.36	−19.8	10.8	3.2	15.1
4H-S1	F	21–40	−12.61	−19.5	10.8	3.5	15
9B1-S3	F	21–40	−11.43	−19.7	14.4	3.2	16.5
12AA-S1	F	21–40	−12.44	−19.3	10.9	3.4	14.5
12DD-S7	F	21–40	−11.55	−20.2	12.4	3.3	12.5
12EE-S2	F	21–40	−12.02	−19.5	12.2	3.4	13.9
12EE-S5	F	21–40	−12.04	−19.3	12.9	3.5	15.8
4K1	M	21–40	−11.92	−19.5	10.5	3.4	13.1
4M1	M	21–40	−12.33	−19.6	13.0	3.2	16.4
12Z-S1	M	21–40	−12.41	−19.4	11.5	3.3	16.7
12DD-S5	M	21–40	−12.01	−19.6	11.5	3.2	16.8
12EE-S1	M	21–40	−11.52	−19.6	11.4	3.5	14.4
9B1-S2	?	21–40	−11.99	−18.9	13.9	3.2	15.6
12AA-S10	?	21–40	−11.38	−19.6	10.7	3.2	13.1
12CC-S2 (B)	?	21–40	−11.87	−19.5	12.0	3.3	15.3
12CC-S3	?	21–40	−11.38	−19.8	12.1	3.3	15.3
12DD-S10	?	21–40	−11.87	−19.9	11.3	3.5	11.7
4G-S1	F	>41	−12.69	−19.3	12.0	3.3	15.1
4L-S4	F	>41	−12.59	−19.3	11.1	3.3	15.8
12AA-S5	F	>41	−12.10	−19.8	11.9	3.9	8.3
4C-S2	M	>41	−13.26	−19.5	12.6	3.3	16.7
4K-S2	M	>41	−11.49	−19.5	12.3	3.3	13.8
11D-S1	M	>41	−13.00	−19.1	12.5	3.3	16.2
12Z-S2	M	>41	−12.75	−19.6	10.2	3.4	16.3
12Z-S3	M	>41	−11.36	−16.7	12.0	3.3	16.4
12BB-S3	M	>41	−12.28	−19.6	10.5	3.3	15.8
12BB-S10	M	>41	−12.29	−19.7	10.0	3.5	14.5
4B-S1	?	?	−12.69	−19.4	11.5	3.3	15.6
12DD-S2	?	?	−11.47	−19.3	11.6	3.3	12.5

(continued)

TABLE A1 (continued)

Burial	Sex	Age group in years	$\delta^{13}C_{carbonate}$ ‰ versus VPDB	$\delta^{13}C_{collagen}$ ‰ versus VPDB	$\delta\ ^{15}N$ ‰ versus AIR	C:N	%N weight
Notre Dame: ***burials found in the southern portion of the cemetery (1733–1796)***							
12C-S2	?	12–20	−11.74	−19.9	9.9	3.3	11.3
12D	?	12–20	−12.53	−19.8	10.7	3.3	15.6
12A-S2	F	21–40	−12.15	−20.0	11.0	3.4	13.3
12W-S13	F	21–40	−13.02	−19.2	10.6	3.3	16.4
12W-S11	?	21–40	−12.67	−19.3	12.6	3.5	15.8
12C-S1	M	>41	−12.18	−20.2	10.7	3.7	10.7
12D-S1	M	?	−12.19	−19.6	11.9	3.3	15.8
12W-S14	M	?	−11.79	−20.1	9.8	3.3	13.2
La Rochelle, France ***(1765–1792)***							
SP 1022	F	?	−10.93	−18.4	11.5	3.1	17.6
SP 1064	F	?	−11.82	−18.8	12.5	3.1	17.1
SP 1069	F	?	−11.45	−17.8	14.8	3.1	17.9
SP 1094	F	?	−11.47	−18.8	12.4	3.3	9.07
SP 10116	F	?	−12.15	−18.7	13.2	3.1	17.4
SP 10117	F	?	−11.98	−18.2	12.5	3.1	18.1
SP 1028	M	?	−11.41	−18.6	11.3	3.2	17.1
SP 1038	M	?	−11.55	−18.2	13.6	3.2	16.9
SP 1052	M	?	−11.88	−18.8	11.5	3.1	17.6
SP 1091	M	?	−11.58	−17.9	13.6	3.1	17.5
SP 1102	M	?	−11.78	−18.2	12.7	3.3	16.5
SP 1009	?	?	−12.47	−18.8	12.5	3.1	17.7
SP 1026	?	?	−11.20	−17.7	12.5	3.1	17.4

F: female; M: male; ?: undetermined sex or age-at-death.