Supplementary Information for

Stable isotope analysis and differences in diet and social status in northern Medieval Christian Spain (9th-13th centuries AD)

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Supplementary Information

Supplementary Text S1. The sites, samples, and their historical context

The region from were we took samples for isotope analysis is, according to Köppen's climate classification, characterized as Cfb. This represents a transitional area between the Atlantic and the Mediterranean climate (Chazarra Bernabé *et al*., 2018).

S1.1. Plaza de San José, Pamplona

Pamplona is the geographical and political centre of the region of Navarre, in the north of Spain. The city is located in a basin surrounded by hills, which open up towards the south and the high valley of the Ebro river. During the Middle Ages, Pamplona developed and reached its peak as the capital, firstly of the kingdom of Pamplona and, from the 12th century AD onwards, of the kingdom of Navarre (Serrano Larráyoz, 2014). The city, like different places across the Iberian Peninsula, was populated by Franks and other nationalities (Martínez García, 2004). This was especially significant with the establishment of the Jacobean route across the kingdom which connected Pamplona to the other main population centres of the region (Josué Simonena *et al*., 2010). The city was divided into three burghs that coexist from the 11th century AD, but primarily from 12th to 15th centuries AD: San Nicolás, formed by free Navarrese individuals and foreigners; San Cernín, where Frankish merchants and artisans lived; and Navarrería with the local population (Josué Simonena *et al*., 2010). Between 2007 and 2010, the company *Gabinete Trama*, under the direction of María Ángeles Mezquíriz, discovered several tombs corresponding to the medieval cemetery of the cathedral of Santa María of Pamplona related to the Navarrería (Josué Simonena *et al*., 2010). Here, eight human individuals, together with six fauna, were analysed. Among them, two human individuals (one female and one male) were found buried with the pilgrim's scallop shell that was associated with the completion of a Medieval pilgrimage to *Santiago de Compostela*. All individuals were buried under the Christian rite (east-west orientation, arms stretched out, and hands over the belly or pelvis).

S1.2. San Roque de las Quintanillas, Burgos (9th-10th century AD) (16)

The archaeological site of San Roque is located in the central area of the province of Burgos, 10 km northwest of the provincial capital. The age of the foundation of the settlement is unknown. Nevertheless, there are written mentions from at least the 11th century AD, and our radiocarbon dating results indicate that it had its origin between the 9th and 10th centuries AD.

A total of 6 individuals were selected and analysed. All individuals were buried following a Christian rite (east-west orientation, arms stretched out, and hands over the stomach or pelvis).

S1.3. San Nicolás de Bari, Burgos (14th-15th century AD) (18)

The church of San Nicolás de Bari is located near the cathedral of Burgos in the city centre. It was a burial place for nobles and bourgeoisie (mainly artisans) during the Middle Ages, when the city was one of the wealthiest in the country. The actual church was founded at the beginning of the 15th century AD over an old Romanesque temple. The remains provided a relative chronology from between the 14th and 15th centuries AD (Lopez, 2009) and were studied osteologically by Lopez (2009) at the University of Oviedo after the site was excavated by the *2B arqueología* company. The osseous material, including faunal samples studied in order to define species, was directly provided by the archaeologists in charge of the excavations, under the responsibility of the Regional Government of Castilla y León.

S1.4. Portales 67, Logroño

Logroño is located in the northern region of La Rioja, on the Ebro river, 384 meters above sea level. Logroño was transformed into a prosperous city thanks to the *Camino de Santiago* (Franco Aliaga, 1979). It is believed that a population existed on the site before the 11th century AD. However, it was not until this time that Alfonso VI granted the fuero or new jurisdiction, and its recognition as a city (Franco Aliaga, 1979). In 2007, during a construction control in the city centre, a medieval necropolis with 54 individuals was discovered by Natalia Bartolomé. All individuals were buried following the Christian rite (east-west orientation, arms stretched out, and hands over the stomach or pelvis). The human remains were partly osteologically analysed (Palomo Díez *et al*., 2011). The vast majority of the individuals were lost. However we were able to to analyse and review 11 individuals, with 7 of these studied for stable isotope analysis.

S1.5. Lobera de Onsella, Zaragoza (10th-11th centuries AD) (24)

Lobera de Onsella is a municipality in the region of Cinco Villas, belonging to the judicial district of Ejea de los Caballeros, in the northwest of the province of Zaragoza. In 2014, a medieval necropolis dating to 10th and 11th century AD was discovered under the direction of José Ignacio Lorenzo (Lorenzo Lizalde, 2018). During this time, Aragon was a county within the Kingdom of Navarra. Through the study of these individuals, one can see the way of life

of rural populations that existed prior to the emergence of the Way of Saint James across the area. In total, the remains of 14 people were found and analysed. All individuals were buried following the Christian rite (east-west orientation, arms stretched out, and hands over the stomach or pelvis). Tombs had a rectangular shape covered with slabs (Lorenzo Lizalde, 2018).

S1.6. Jaca, Zaragoza (13th-15th centuries AD)

Jaca is a city in northeastern Spain in the province of Huesca, located near the Pyrenees and the border with France. Jaca was the city out of which the County and Kingdom of Aragon developed. It was the capital of Aragon until 1097 (Buesa Conde, 2002). When Jaca became the first royal seat of Ramiro I (1006-1063), people dedicated to administration and merchants began to arrive, transforming it from a village exclusively devoted to livestock and agriculture into an urban centre (Buesa Conde, 2002). Between 2006 and 2007, archaeological excavations were carried out in Biscós Square in Jaca, next to Saint Peter's Cathedral. These were directed by Julia Justes Floría and Rafael Domingo Martínez. The necropolis emerged in the 11th century AD and was in continuous use until the first half of the 16th century AD (Justes Floria and Domingo Martínez, 2007).

S1.7. Sancho Ramírez, Count of Ribagorza (1040 – 1105 AD)

Sancho Ramírez was the illegitimate son of King Ramiro I of Aragon, who named him Count and lord of Ribagorza, Aibar, and Javierrelatre, among other territories. He became one of the great benefactors of the city of Jaca and the cathedral, where he was eventually buried, until his death in 1105 AD (Lapeña Paul, 2004).

S1.8. Saint Raymond William or San Ramón de Rodas (1067-1126 AD)

Raimon Guillem was born to a noble family from Durban (France). Alfonso I of Aragón granted him the diocese of Barbastro-Roda in 1104, with its headquarters in the Cathedral of Roda. In 1116, the bishop Esteban of Huesca, with the support of nobles of Barbastro and King, succeeded him as bishop of Roda. Ramón was forced to leave until 1119, when he could become bishop of Barbastro-Roda again. In 1125, he accompanied King Alfonso during the military campaign in Granada. During this trip, Raimon Guillem became sick and died on his return to Huesca on June 21, 1126 AD. His body was interred at Roda´s cathedral on June 26. He is venerated as a saint by the Catholic Church (Iglesia Costa, 1998).

S1.9. Abbey of San Pedro de Siresa, Huesca, Aragon (9th-10th centuries AD)

This Romanesque monastery is probably the oldest of the kingdom of Aragon, located 822m above sea level in the Pyrenean valley of Hecho, in the town of Siresa, within the province of Huesca. It was constructed between the 9th and 13th centuries AD (Buesa Conde, 2002b). The archaeologist and anthropologist José Ignacio Lorenzo-Lizalde analysed the remains of two individuals that, following their location and characteristics, were identified as one knight and one monk who potentially could be an abbot of the monastery.

S1.10. Unknown Princess of Aragon (11th-12th centuries AD)

This individual was buried at the medieval royal pantheon of San Pedro el Viejo (Huesca, Aragon, Spain). There are no documentary or material records to help us identify the exact royal member buried in this tomb (Buisán Chaves, 2018).

S1.11. Bishop Pedro de Librana (1119-1128 AD)

Human remains were found under the main altar of the Seo Cathedral of Zaragoza which, after an osteological examination and following the historical records, were assigned to Pedro de Librana, the first bishop of Zaragoza after the conquest of the city by the Christian kingdom of Aragon (Lorenzo Lizalde, 1998; Naya Franco, 2017). He was a monk who was born in the south of France, probably in Béarna. He was responsible for converting mosques into churches, and the relocation of the Muslim population to the suburbs. He also participated in the military expedition of Alfonso I of Aragon in Andalusia (Dorronzoro Ramírez, 2014).

S2. Radiocarbon Dating

S2.1. Oxford Radiocarbon Accelerator Unit (ORAU)

The human bone from the necropolis of San Roque de las Quintanillas, Burgos; Portales 67, Logroño; Plaza de San José, Pamplona; and Plaza Biscós in Jaca (Huesca, Aragon) were radiocarbon dated at the Oxford Radiocarbon Accelerator Unit (ORAU). Prior to extensive sampling of human skeletal remains, we screened small (3–5 mg) sub-samples of drilled bone powder by measuring the elemental nitrogen concentration. This is a useful proxy for protein, and therefore presence of collagen in the bone (Brock *et al*., 2010; Jacob *et al*., 2018). Samples with >~0.5%N were passed for full collagen extraction treatment for AMS dating. The methods used are outlined in Brock *et al*. (2010). Briefly, collagen was extracted using an acid-base-acid procedure followed by gelatinization and lyophilization (Brock *et al*. 2010). The extracted

gelatine was filtered using pre-cleaned Vivaspin™30kD MWCO ultra-filters (Brown *et al*. 1988; Higham *et al*. 2006). Ultrafiltration removes low molecular weight contaminants and produces a better purified collagen fraction as indicated by improved C:N atomic ratios and carbon mass on combustion. The filtered collagen was freeze-dried and combusted in a CHN analyzer in continuous flow mode linked to a Europa isotope ratio mass spectrometer (EA-CF-IRMS) using He as carrier gas. $\delta^{13}C$ and $\delta^{15}N$ values, nitrogen and carbon content, and bone C:N atomic ratios were determined. The purified CO_2 was then reduced to graphite using H_2 in a reaction catalyzed by 2 mg of Fe powder at 560°C for 6 hr. The graphite was pressed into an Al target holder prior to radiocarbon measurement using AMS (Bronk Ramsey *et al*. 2004). We tested the reliability of dating bone with collagen yields of this size and the models showed that none were outliers. All other analytical parameters measured, including the carbon to nitrogen atomic ratio, were acceptable. We therefore consider the results to be robust. The calibration and the calibration curve were performed by OxCal V4.4 Bronk Ramsey (2021): r.5: IntCarl13 atmospheric curve (Reimer *et al*. 2020).

S2.2. Beta Analytic

We also sent human bone from Lobera de Onsella, Zaragoza, Aragon; and San Pedro de Siresa, Huesca, Aragon to be radiocarbon dated at the Beta Analytics Laboratories, Florida. Before radiocarbon dating, the samples were first gently crushed then dispersed in deionized water. They were then washed with hot HCl acid to eliminate carbonates followed by an alkali wash (NaOH) to remove secondary organic acids. The alkali wash is followed by a final acid rinse to neutralize the solution before drying. After this, the samples for radiocarbon dating were bathed in sodium chlorite (NaClO2) under controlled conditions (pH 3 and temperature at 70°C). The AMS measurement was done on graphite produced by hydrogen reduction of the CO_2 sample over a cobalt catalyst. The CO_2 was obtained from the combustion of the sample at 800°C+ under a 100% oxygen atmosphere. The CO_2 is first dried with methanol/dry ice then collected in liquid nitrogen for the subsequent graphitization reaction. The identical reaction is performed on reference standards, internal QA samples, and backgrounds to ensure systematic chemistry. The analytical results ("BP" or "pMC") were obtained by measuring sample C^{14}/C^{13} relative to the C^{14}/C^{13} in Oxalic Acid II (NIST-4990C) in one of Beta Analytic's multiple in-house particle accelerators using SNICS ion source. Quality assurance samples were measured along with the unknowns and reported separately. The AMS results have been corrected for total fractionation using machine graphite $\delta^{13}C$. The IRMS performs the separation and measurement of the CO_2 masses (44, 45, and 46) and calculation of the sample $\delta^{13}C$.

S3. $\delta^{13}C$ and $\delta^{15}N$ analysis of bone collagen

Collagen was extracted using standard procedures following Richards and Hedges (1999) at the Max Planck Institute for the Science of Human History in Jena, Germany. 0.7 gram to 1 gram of bone or tooth dentine was demineralised in 10ml aliquots of 0.5M HCL at 4°C, where the acid was changed every day until CO_2 stopped evolving. The residue was rinsed three times in Milliq© water before being gelatinised in pH3 HCl at 75°C for 48 hours. The resulting solution was filtered with Ezee filters, with the supernatant then being lysophilized over a period of 24 hours. After calculating the collagen yield, from the purified collagen sample 1mg was weighed out twice and placed into tin capsules to be analysed in duplicate by the elemental analyser/continuous flow isotope ratio mass spectrometry (EA-IRMS), using a ThermoFisher Elemental Analyser coupled to a ThermoFisher Delta V Advantage Mass Spectrometer via a ConFloIV system. Isotopic values are reported as the ratio of the heavier isotope to the lighter isotope (13C/12C or 15N/14N) as δ values in parts per mille (‰) relative to international standards, VPDB for δ13C and atmospheric N2 (AIR) for δ15N. $\delta^{13}C$ and $\delta^{15}N$ of the samples were calibrated using linear regression based on the measured values of international standard reference materials within each analytical run. Those were USGS40 L-Glutamic Acid: $\delta^{13}C$ -26.389 ± 0.042 ‰, $\delta^{15}N$ = -4.5 ± 0.1‰; IAEA-N-2 Ammonium Sulfate: $\delta^{15}N$ = +20.3 ± 0.2‰; IAEA-CH-6 Sucrose: $\delta^{13}C$ = -10.449 ± 0.03‰. An in house fish gelatine standard was used to determine overall measurement precision. Based on replicate analyses long-term machine error over a year is ± 0.2‰ for $\delta^{13}C$ and ± 0.2‰ for $\delta^{15}N$. The atomic C:N ratio along with the collagen yields were used in order to determine the quality of collagen preservation. Collagen yields over 1 wt% were considered acceptable for carbon and nitrogen values (van Klinken, 1999), while the C:N ratio should have a range from 2.9 to 3.6 (DeNiro, 1985).

Supplementary Tables

Table S1. Statistical analysis comparison between social status/origin (Kruskal-Wallis test for equal medians, and Mann-Whitney pairwise with Bonferroni correction), and between biological sexes (Mann-Whitney test for equal medians with Monte Carlo permutation)

	Rural (n=20)	Urban (n=14)	Social Elite (n=6)
Rural (n=20)	-	$\delta^{15}N$: 0.0054 $\delta^{13}C$: 1	$\delta^{15}N$: 0.0235 $\delta^{13}C$: 1
Urban (n=14)	$\delta^{15}N$: 0.0054 $\delta^{13}C$: 1	-	$\delta^{15}N$: 0.4779 $\delta^{13}C$: 1
Social Elite (n=6)	$\delta^{15}N$: 0.0235 $\delta^{13}C$: 1	$\delta^{15}N$: 0.4779 $\delta^{13}C$: 1	-
Rural, Urban, and Social Elite comparison (Kruskal-Wallis test for equal medians) $\delta^{15}N$: 0.0009 $\delta^{13}C$: 0.5811			
Female and Male comparison (Mann-Whitney test for equal medians, Monte Carlo permutation) $\delta^{15}N$: 0.975 $\delta^{13}C$: 0.419			

Table S2. Radiocarbon dating results calibrated using OxCal. v4.4 Bronk Ramsey (2017) and the IntCal13 atmospheric curve (Reimer *et al.*, 2020)

Lab code	Sample code	Location	Material	Radiocarbon years before present (BP)	$\delta^{13}C$ (‰) (VPDB)	Calibrated calendar date (95,4%)*
OxA-38172	SRQ(BUR)30	San Roque de las Quintanillas, Burgos	Tooth *Homo sapiens*	1123±27	-18.7	775-994 cal AD
OxA-38171	P67(RIJ)10	Portales 67, Logroño, La Rioja	Bone *Homo sapiens*	777±26	-19.1	1223-1279 cal AD
OxA-38168	PSJP(NAV)01	Plaza de San José, Pamplona	Bone *Homo sapiens*	843±26	-20.8	1164-1262 cal AD
Beta-464469	T-11	Lobera de Onsella	Tooth *Homo sapiens*	960±30	-18.4	1025-1160 cal AD
Beta-464468	T-5	Lobera de Onsella	Tooth *Homo sapiens*	1060±30	-19.3	895-1030 cal AD
Beta-283032	T-1 Niv 1	San Pedro de Siresa	Bone *Homo sapiens*	1000±40	-18.9	989-1160 cal AD

Table S3. $\delta^{13}C$ and $\delta^{15}N$ stable isotope ratios, collagen quality indicators, and species identification of fauna analysed at the present study

Reference	Place	Chronology	Laboratory	Species	$\delta^{15}N$ (‰) (AIR)	$\delta^{13}C$ (‰) (VPDB)	N%	C%	C/N	Collagen Yield (%)
SMB(CAN)FAU01	Santa María de Bareyo, Cantabria	9^{th}-15^{th} centuries AD	UDC	*Bos taurus*	5.1	-21.1	13.3	34.4	3.0	4.2
SNB(BUR)FAU03	San Nicolás de Bari (Burgos, Castile and Leon)	12^{th}-14^{th} centuries AD	MPI	Ovicaprine	5.7	-19.7	14.7	42.7	3.4	6.8

SNB(BUR)FAU04	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	Ovicaprine	4.1	-19.9	18.9	48.1	3	17.9
SNB(BUR)FAU05	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	Sus scrofa	9.1	18.7	16.2	43.8	3.1	18.3
SNB(BUR)FAU06	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	*Gallus gallus*	9.4	-18.9	19.3	49.4	3	16.6
SNB(BUR)FAU07	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	Ovicaprine	3.4	-19.4	18.8	47.4	2.9	18.2
SNB(BUR)FAU09	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	Ovicaprine	6.2	-19.9	15.9	43.2	3.2	10.6
SNB(BUR)FAU10	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	Ovicaprine	6.9	-20.6	13.4	35.4	3.1	10
SNB(BUR)FAU12	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	*Bos taurus*	5.1	-19.7	16.4	46.6	3.3	15.6
SNB(BUR)FAU14	San Nicolás de Bari (Burgos, Castile and Leon)	12th-14th centuries AD	MPI	Sus scrofa	8.8	-20.6	13.6	38.8	3.3	5.4
P67(RIJ)FAU01	Calle Portales 67 (Logroño, La Rioja)	13th century AD	MPI	*Bos taurus*?	2.3	-21.9	15.2	40.8	3.1	19.1
P67(RIJ)FAU02	Calle Portales 67 (Logroño, La Rioja)	13th century AD	MPI	Ovicaprine	5.3	-20.5	13.3	37.0	3.2	9.9
P67(RIJ)FAU05	Calle Portales 67 (Logroño, La Rioja)	13th century AD	MPI	*Bos taurus*?	3.9	-20.9	19.0	48.4	3	30.3

P67(RIJ)FAU07	Calle Portales 67 (Logroño, La Rioja)	13th century AD	MPI	Ovicaprine ?	4.4	-19.7	15.5	42.6	3.2	3
P67(RIJ)FAU08	Calle Portales 67 (Logroño, La Rioja)	13th century AD	MPI	Ovicaprine ?	5	-19.5	15.6	42.6	3.2	11.0
PSJ(FAU)NAV01	Plaza de San José, Pamplona (Navarre)	12th-13th centuries AD	MPI	*Sus scrofa?*	8.4	-20.9	15.8	44.1	3.3	9.2
PSJ(FAU)NAV02	Plaza de San José, Pamplona (Navarre)	12th-13th centuries AD	MPI	Ovicaprine	6.7	-20.1	13.6	37.5	3.2	9.9
PSJ(FAU)NAV04	Plaza de San José, Pamplona (Navarre)	12th-13th centuries AD	MPI	*Bos taurus*?	4.7	-20.6	15.3	43.1	3.3	12
PSJ(FAU)NAV05	Plaza de San José, Pamplona (Navarre)	12th-13th centuries AD	MPI	*Bos taurus*	5.1	-21.5	14	38.6	3.2	1.7
PB(ARG)FAU29	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	*Bos Taurus?*	5.1	-20.2	15.3	41.9	3.2	8.8
PB(ARG)FAU30	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	*Bos taurus*	4.8	-21.5	14.7	40.5	3.2	3.5
PB(ARG)FAU31	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	*Bos taurus*	3.7	-21.8	14	38.7	3.2	4.9
PB(ARG)FAU32	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	*Bos taurus*	4.8	-20.5	17.1 %	47.0 %	3.2	15.8
PB(ARG)FAU35	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	Ovicaprine	3.1	-20.0	16	44.3	3.2	5.8

PB(ARG)FAU36	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	Ovicaprine	4.5	-19.5	16.2	43.7	3.1	
PB(ARG)FAU37	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	Ovicaprine	4.9	-19.9	16.1	44.1	3.2	19.7
PB(ARG)FAU38	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	Ovicaprine	8.6	-20.6	16.5	45.3	3.2	12.2
PB(ARG)FAU39	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	*Bos taurus*	4.4	-20.3	14.6	40.6	3.2	3.1
PBJ(ARG)FAU42	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	Ovicaprine	6.1	-20.0	14.6	41.4	3.3	4.2
PBJ(ARG)FAU43	Plaza Biscós, Jaca (Huesca, Aragon)	13th-15th centuries AD	MPI	Ovicaprine	4.1	-22.1	15.7	44.2	3.3	25.2

Table S4 Human $\delta^{13}C$ and $\delta^{15}N$ stable isotope ratios, collagen quality indicators, location, chronology, and laboratory

Reference and Chronology	Site	Sex and Age estimation**	Sample	$\delta^{15}N$ (‰)(AIR)	$\delta^{13}C$ (‰)(VPDB)	%N	%C	C/N	Collagen Yield (%)
SRQ(BUR)01b 9th-10th centuries AD	San Roque de las Quintanillas	Male Later Middle Adult	LM^2	10.3	-18.2	16.6	45.8	3.2	17.8
SRQ(BUR)05 9th-10th centuries AD	San Roque de las Quintanillas	Ind. Later Middle Adult	LM_2	8.4	-18.6	17.4	45.9	3.1	18.7
SRQ(BUR)14 9th-10th centuries AD	San Roque de las Quintanillas	Male Mature Adult	RM^2	9.4	-18.6	16.6	45.8	3.2	18.7
SRQ(BUR)19 9th-10th centuries AD	San Roque de las Quintanillas	Male Ind. Adult	LM_2	9	-18.6	16.4	45.6	3.2	18.1
SRQ(BUR)21 9th-10th centuries AD	San Roque de las Quintanillas	Male Mature Adult	LM^2	11.2	-16.3	16.7	46.0	3.2	17.9
SRQ(BUR)023 9th-10th centuries AD	San Roque de las Quintanillas	Male Later Middle Adult	LM^2	9.8	-18.4	16.6	45.6	3.2	18.1
P67(RIJ)01 13th century AD	Portales 67, Logroño	Male Mature Adult	LM_2	9.9	-18.5	16.2	43.5	3.1	20.7
P67(RIJ)02 13th century AD	Portales 67, Logroño	Male Early Middle Adult	RM_2	9.5	-19.1	16.2	44.2	3.2	18.8

P67(RIJ)05 13th century AD	Portales 67, Logroño	Male Early Middle Adult	LM_2	10.3	-18.5	16.3	44.0	3.2	19.7
P67(RIJ)09 13th century AD	Portales 67, Logroño	Male Young Adult	RM_2	11	-18.1	16.5	44.6	3.2	18.7
P67(RIJ)10 13th century AD	Portales 67, Logroño	Female Young Adult	RM_2	12.2	-18.6	16.4	44.0	3.1	17.8
P67(RIJ)11 13th century AD	Portales 67, Logroño	Male Later Middle Adult	RM^2	8.8	-19.2	19.1	49.4	3	21.3
P67(RIJ)12 13th century AD	Portales 67, Logroño	Male Early Middle Adult	LM_2	11.7	-18.5	16.6	44.4	3.1	20.0
PSJP(NAV)01 (Pilgrim) 12th-13th centuries AD	Plaza San José, Pamplona	Female Later Middle Adult	Rib	10.6	-21	13.5	39.3	3.4	8.3
PSJP(NAV)02b 12th-13th centuries AD	Plaza San José, Pamplona	Ind. Mature Adult	Rib	9.9	-18.9	16.2	44.9	3.2	12.8
PSJP(NAV)04 (Pilgrim) 12th-13th centuries AD	Plaza San José, Pamplona	Male Early Middle Adult	Rib	9.9	-19.7	15.0	41.7	3.3	13.8
PSJP(NAV)05 12th-13th centuries AD	Plaza San José, Pamplona	Male Young Adult	Rib	9.8	-18.1	15.7	44.6	3.3	15.8
PSJP(NAV)06 12th-13th centuries AD	Plaza San José, Pamplona	Male Ind. Adult	Rib	11.5	-15.3	15.6	43.8	3.3	10.3
PSJP(NAV)07 12th-13th centuries AD	Plaza San José, Pamplona	Male Mature Adult	Rib	10.4	-19.1	14.7	41.2	3.3	11.3
PSJP(NAV)08 12th-13th centuries AD	Plaza San José, Pamplona	Male Mature Adult	RM_2	12.0	-19.2	16.4	46.0	3.3	16.2
LOZ(ARG)01 10th-11th centuries AD	Lobera de Onsella	Female Mature Adult	Rib	9.4	-18.8	15.8	43.2	3.2	21.2
LOZ(ARG)02 10th-11th centuries AD	Lobera de Onsella	Male Early Middle Adult	Rib	9.6	-18.9	16.8	46.4	3.2	18.7
LOZ(ARG)03 10th-11th centuries AD	Lobera de Onsella	Indeterminate Ind. Adult	Rib	9.5	-18.6	16.0	44.8	3.3	9.1
LOZ(ARG)04 10th-11th centuries AD	Lobera de Onsella	Female Mature Adult	Rib	9.6	-18.7	15.9	43.7	3.2	19.6
LOZ(ARG)05 10th-11th centuries AD	Lobera de Onsella	Male Later Middle Adult	Rib	9.4	-17.9	17.5	46.1	3.1	10.8
LOZ(ARG)06 10th-11th centuries AD	Lobera de Onsella	Female Mature Adult	Rib	9.5	-19	16.5	45.5	3.2	19.1
LOZ(ARG)07 10th-11th centuries AD	Lobera de Onsella	Male Mature Adult	Rib	9.5	-18.7	15.7	42.9	3.2	13.3
LOZ(ARG)08 10th-11th centuries AD	Lobera de Onsella	Male Mature Adult	Rib	9.2	-18.6	15.6	42.9	3.2	11.8
LOZ(ARG)09 10th-11th centuries AD	Lobera de Onsella	Male Early Middle Adult	Rib	10.4	-19.2	15.9	43.3	3.2	25.7
LOZ(ARG)10 10th-11th centuries AD	Lobera de Onsella	Male Mature Adult	Rib	10.4	-18.3	15.9	45.7	3.3	23.8
LOZ(ARG)11 10th-11th centuries AD	Lobera de Onsella	Indeterminate Adult	Rib	8.3	-18.5	16.3	46.7	3.3	25.6
LOZ(ARG)12 10th-11th centuries AD	Lobera de Onsella	Indeterminate	Rib	9.3	-18.5	16	44.3	3.2	23.7
LOZ(ARG)13 10th-11th centuries AD	Lobera de Onsella	Male Mature Adult	Rib	9.4	-18.5	14.8	41.2	3.3	7.4
LOZ(ARG)14 10th-11th centuries AD	Lobera de Onsella	Female Young Adult	Rib	9.4	-19.3	15.4	44	3.3	5.7
Saint Raymond William or San Ramón de Roda 11th-12th centuries AD	Catedral de San Vicente de Roda de	Male Mature Adult	Rib	12.4	-18.6	15.8	46	3.4	16.2

	Isábena, Huesca								
Sancho Ramírez, Count of Ribagorza 11th century AD	San Pedro Carhedral, Jaca (Huesca, Aragón)	Male Mature Adult	Rib	11.9	-18.4	15.7	44.2	3.3	13.9
Pedro de Librana. Bishop of Zaragoza 11th-12th centuries AD	Cathedral of Salvador (Zaragoza, Aragón)	Male Mature Adult	Femur	13.7	-18.6	15.1	45.4	3.5	2.9
Unknown Princess Aragon 10th-12th centuries AD	Monastery of San Pedro el Viejo (Huesca, Aragón)	Female Young Adult	Rib	13.3	-17.8	16.1	46.1	3.3	8.8
SPSH(ARG)01B(Monk) 9th-10th centuries AD	Monastery of San Pedro de Siresa (Huesca, Aragon)	Male Mature Adult	Rib	9.9	-19.1	15.3	43.2	3.3	13.8
SPSH(ARG)03T(Knight) 9th-10th centuries AD	Monastery of San Pedro de Siresa (Huesca, Aragon)	Male Later Middle Adult	Rib	9.4	-18.8	16.4	45	3.2	27.5

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231 **Table S5. $\delta^{13}C$ and $\delta^{15}N$ human measurements compiled from the literature.**

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Site and Location	**# in map (Figure 1)**	**Social Group and Chronology**	**$\delta^{15}N$ (‰) and $\delta^{13}C$ (‰) Mean ± SD, Range and number of samples**	**Reference**
Capela do Pilar, Santa María Cathedral (Lugo, Galicia)	11	Social Elite Members of the cathedral clergy (12th-14th century)	13.7±0.9 (7.1 to 11.2) -18.5 ± 0.6 (-22.6 to -20.8) n = (6)	López-Costas, 2012
San Salvador Cathedral (Oviedo, Asturias)	12	Social Elite Members of the cathedral clergy (10th century)	12.0±1.2 (10.3 to 13) -18.6 ± 0.2 (-19.9 to -18.4) n = (4)	MacKinnon et al., 2019
EM Dulantzi Alegría-Dulantzi (Álava, Basque Country)	13	Rural (8th-12th century)	9.1±1.2 (4.7 to 12.2) -18.8 ± 1.4 (-24.5 to -14.1) n = (45)	Lubritto et al. 2017
EM Aistra Zalduondo (Álava, Basque Country)	14	Rural (8th-10th century)	8.0±1.1 (6.7 to 12.1) -18.9±1.0 (-22 to -16.7) n = (44)	Lubritto et al. 2017
Treviño, Condado de Treviño (Burgos, Castile and León)	15	Rural (12th-15th century)	9.6±1.1 (7.5 to 12) -19.5±0.7 (-22 to -18.7) n = (19)	Lubritto et al. 2017
Las Gobas Treviño, Burgos (Castile and León)	16	Rural (7th-11th century)	8.9±0.9 (7.7 to 11.7) -19.0±0.6 (-20.1 to -17.2) n = (40)	Guede et al. 2018
Palacios de la Sierra (Burgos, Castile and León)	18	Rural (13th-15th century)	9.4±1.5 (6.8 to 10.6) -18.9±0.8 (-20.3 to -18.2) n = (5)	Jiménez-Brobeil et al. 2016
San Baudelio de Berlanga, Soria	18	Rural, Christian 11th-12th centuries AD	10.3±0.5 (9.3 to 11.5) -18.2±0.4 (-19.0 to -17.6) n = (20)	Jiménez-Brobeil et al. 2020

Tauste, Zaragoza	19	Urban, Muslim 8^{th}-10^{th} centuries AD	14.9±1.7 (9.6 to 17.5) -19.1±0.5 (-19.9 to -17.0) n = (20)	Guede et al., 2017
Zaragoza	8	Urban, Muslim 10^{th}-12^{th} centuries AD	10.9±1.4 (9.0 to 14.1) -19.0±0.3 (-19.6 to-18.2) n = (36)	Mundee, 2010
Albarracín, Teruel	20	Urban, Muslim 8^{th}-10^{th} centuries AD	10.8±0.8 (9.4 to 12.1) -19.0±0.2 (-19.4 to-18.5) n = (31)	Mundee, 2010
Castile Royal Family, Virgen de los Reyes chapel, Santa María de la Sede Cathedral (Seville, Andalusia)**	21	Social Elite Royal family of Castile Kingdom (14^{th} century)	13.3±1.5 (11.9 to 15.6) -18.6 ± 0.5 (-19.3 to -18) n = (5)	Jiménez-Brobeil et al. 2016

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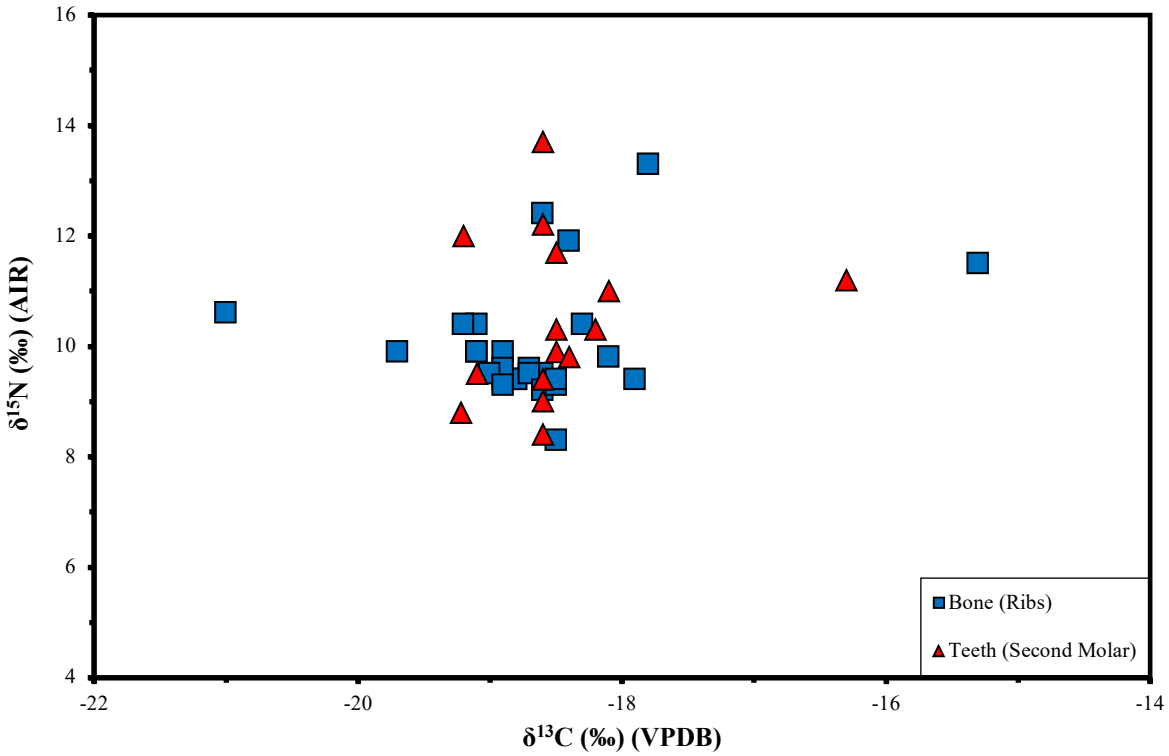
Supplementary Figures

Figure S1. $\delta^{13}C$ and $\delta^{15}N$ data of teeth and ribs comparison from the human individuals analysed in this study.



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