

Supplementary materials

Table S1. Tested samples with their brief description and origin.

Sample	Characteristics	Source	GPS
A	Hemp stem, length: 2 m	Carpi	44.706046, 10.847027
A₀₋₁	First quarter, basal of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₀₋₂	Second quarter of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₀₋₃	Third quarter of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₀₋₄	Apical section of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₁₋₁	First quarter, basal of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₁₋₂	Second quarter of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₁₋₃	Third quarter of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₁₋₄	Apical section of the hemp stem, length: 50 cm	Carpi	44.706046, 10.847027
A₂	External part of the Carpi stem obtained by separation by the central part	Carpi	44.706046, 10.847027
C	Fibrous part of the Carpi stem	Carpi	44.706046, 10.847027
E	Fedora variety hemp stem mixed with fiber, harvested in 2022	Udine	46.027855, 13.282296
F	Hemp stem mixed with fiber	Modena	44.623222, 10.997917
H	Hemp stem, harvested in the 2022	Brennero	46.996725, 11.500710
J₁	Hemp stem, harvested in 2020, length: 2 m; basal section of the stem, length 50 cm	Parma	44.837437, 10.434464
J₂	Hemp stem approximately 2 meters high harvested in 2020. Central section closest to the basal part of the stem, length: 50 cm	Parma	44.837437, 10.434464
J₃	Hemp stem approximately 2 meters high harvested in 2020. Central section furthest from the basal part of the stem, length: 50 cm	Parma	44.837437, 10.434464
J₄	Hemp stem approximately 2 meters high harvested in 2020. Central section furthest from the basal part of the stem, length: 50 cm	Parma	44.837437, 10.434464
K₁	Hemp stem approximately 2 meters high harvested in 2023. Basal section of the stem, length: 50 cm	Modena	44.592862, 10.994557
K₂	Hemp stem approximately 2 meters high harvested in 2023. Central section closest to the basal part of the stem, length: 50 cm	Modena	44.592862, 10.994557
K₃	Hemp stem approximately 2 meters high harvested in 2023. Central section furthest from the basal part of the stem, length: 50 cm	Modena	44.592862, 10.994557

K₄	Hemp stem approximately 2 meters high harvested in 2023. Central section furthest from the basal part of the stem, length: 50 cm	Modena	44.592862, 10.994557
L₁	Hemp stem approximately 2 meters high harvested in 2020, of the Fedora variety. Basal section, length: 50 cm	Parma	44.837437, 10.434464
L₂	Hemp stem approximately 2 meters high harvested in 2020, of the Fedora variety. Central section closest to the basal part of the stem, length: 50 cm	Parma	44.837437, 10.434464
L₃	Hemp stem approximately 2 meters high harvested in 2020, of the Fedora variety. Central section furthest from the basal part of the stem, length: 50 cm	Parma	44.837437, 10.434464
L₄	Hemp stem approximately 2 meters high harvested in 2020, of the Fedora variety. Apical section of the stem, length: 50 cm	Parma	44.837437, 10.434464
M	Hemp presented in the form of short stems harvested in 2022	Brunico	46.803817, 11.927770
N₁	Hemp presented in the form of a short stem harvested in 2019	Modena	44.623222, 10.997917
N₂	Hemp presented in the form of short stems harvested in 2019	Modena	44.623222, 10.997917
28	Chopped hemp harvested in 2021, sample provided by CREA	Caserta	41.135526, 14.238501
48	Hemp harvested in 2022, sample provided by CREA	Bari	40.974270, 17.147109
54	Hemp harvested in 2022, sample provided by CREA	Rovigo	45.038195, 11.850637



Figure S1. Map of sampling sites

Table S2. Mineralization ramp of the samples. E, microwave power; t, duration time of the step; T1, internal temperature of the container; T2, external limit temperature of the magnetron; P, maximum pressure of the mineralization chamber.

Step	E Watt	t min.	T1 °C	T2 °C	P bar
1	1500	5	100	60	160.0
2	1500	15	210	60	160.0
3	1500	5	210	60	160.0

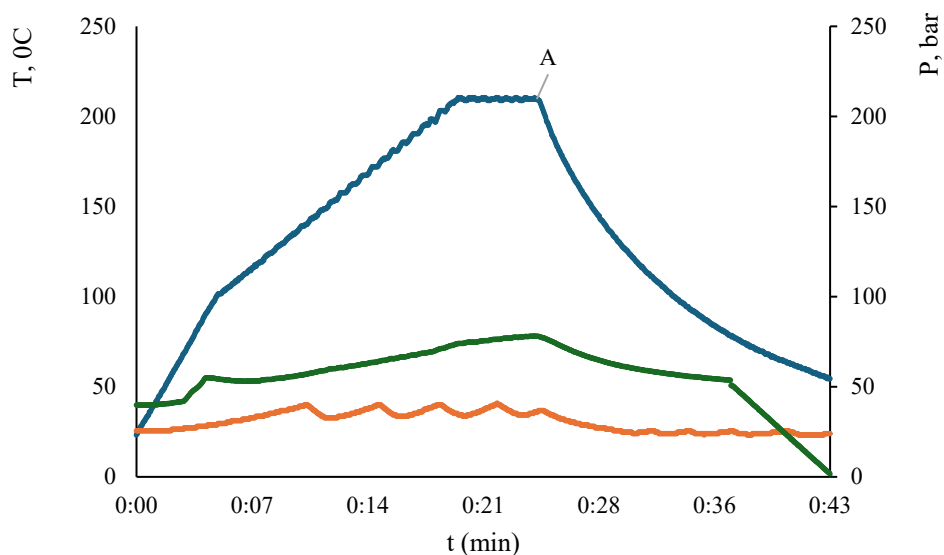


Figure S2. Trend of the temperature (blue line), pressure (green line) and autoclave cylinder temperature (orange line) parameters relating to the mineralization process of the hemp samples.

Table S3. Experimental conditions used for the determination of Li, Na, K, Mg and Ca using the FAAS technique.

Element	Absorption/ Emission	Fiamma	Cs ppm	La ppm	λ nm
Li	Emission	Acetylene/Air	2000	/	670.8
Na	Absorption	Acetylene/Air	2000	/	589.0
K	Absorption	Acetylene/Air	2000	/	766.5
Mg	Absorption	Acetylene/N ₂ O	/	5000	285.2
Ca	Absorption	Acetylene/Air	/	5000	422.7

Table S4. Heating program for the determination of Sr concentration using the GFAAS technique.
The asterisked steps represent the signal reading stages.

Step	T °C	t s	Flow L/min	Gas Type
1	85	5.0	3.0	Ar
2	95	40.0	3.0	
3	125	10.0	3.0	
4	210	5.0	3.0	
5	210	5.0	3.0	
6	1000	10.0	3.0	
7	1000	8.0	3.0	
8	1000	2.0	0.0	
*9	2700	0.9	0.0	
*10	2700	2.5	0.0	
11	2700	5.0	3.0	

Table S5. Mass/charge ratio value measured for each element examined.

Element	Species measured	<i>m/z</i>
¹¹ B	¹¹ B	11
⁵² Cr	⁵² Cr ¹⁶ O	68
⁵⁵ Mn	⁵⁵ Mn	55
⁵⁶ Fe	⁵⁶ Fe	56
⁵⁹ Co	⁵⁹ Co	59
⁶⁰ Ni	⁶⁰ Ni	60
⁶³ Cu	⁶³ Cu	63
⁶⁶ Zn	⁶⁶ Zn	66
⁸⁵ Rb	⁸⁵ Rb	85
⁸⁸ Sr	⁸⁸ Sr ¹⁶ O	104
⁹⁸ Mo	⁹⁸ Mo ¹⁶ O	114
¹¹¹ Cd	¹¹¹ Cd	111
¹¹⁸ Sn	¹¹⁸ Sn	118
¹³⁸ Ba	¹³⁸ Ba ¹⁶ O	154
²⁰² Hg	²⁰² Hg	202
²⁰⁵ Ti	²⁰⁵ Ti	205
²⁰⁸ Pb	²⁰⁸ Pb	208
²⁰⁹ Bi	²⁰⁹ Bi	209

Table S6. Values of the elements measured for the control sample C.

Sample C				
Element	Min	Max	Average	SD
Major component (mg/kg)				
K	15402	15585	15473	98
Ca	11713	11913	11787	110
Minor component (mg/kg)				
Mg	1620	1656	1633	20
Na	547	633	589	43
Fe	471	506	486	11
Trace component (mg/kg)				
Sr	80	102	92	8
Li	55	66	61	6
Mn	30	33	31	1
Zn	26	30	27	1
B	20	22	21	1
Ba	17	20	18	1
Cu	6.58	7.59	7.07	0.33
Rb	3.94	4.30	4.10	0.12
Ni	1.62	1.95	1.73	0.11
Cr	1.58	1.77	1.67	0.06
Pb	0.59	0.70	0.64	0.03
Sn	0.21	0.26	0.24	0.02
Co	0.21	0.22	0.22	0.01
Ultra-trace component (µg/kg)				
Mo	81	93	86	4
Cd	57	62	60	1
Bi	8.38	9.64	8.89	0.41
Tl	7.60	8.93	8.20	0.42
Hg	1.54	1.99	1.77	0.16

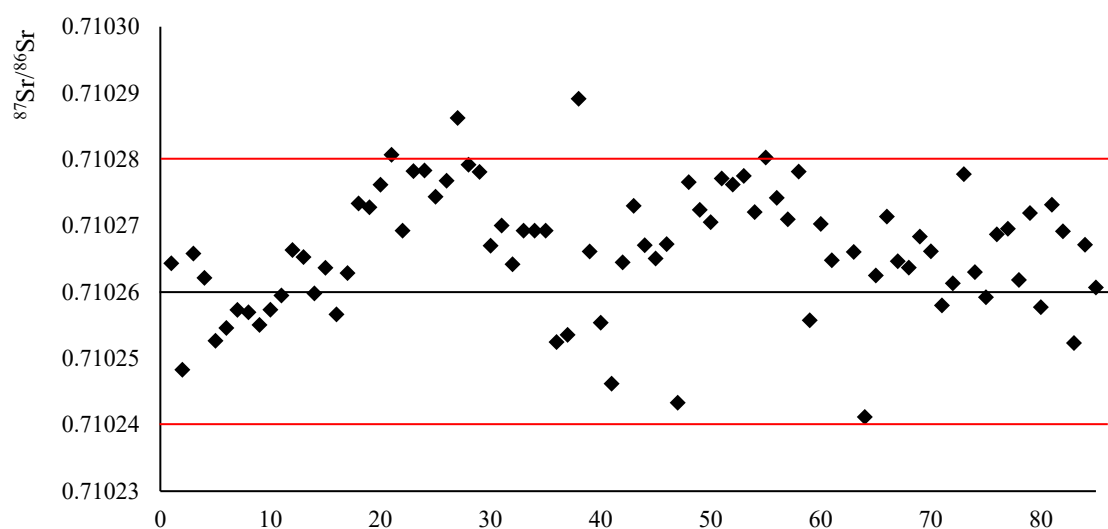


Figure S3. Trend of the isotope ratio values for the NIST 987 standard. The figure shows the generally accepted ratio value of 0.710263 and the associated uncertainty interval ± 0.000016 .

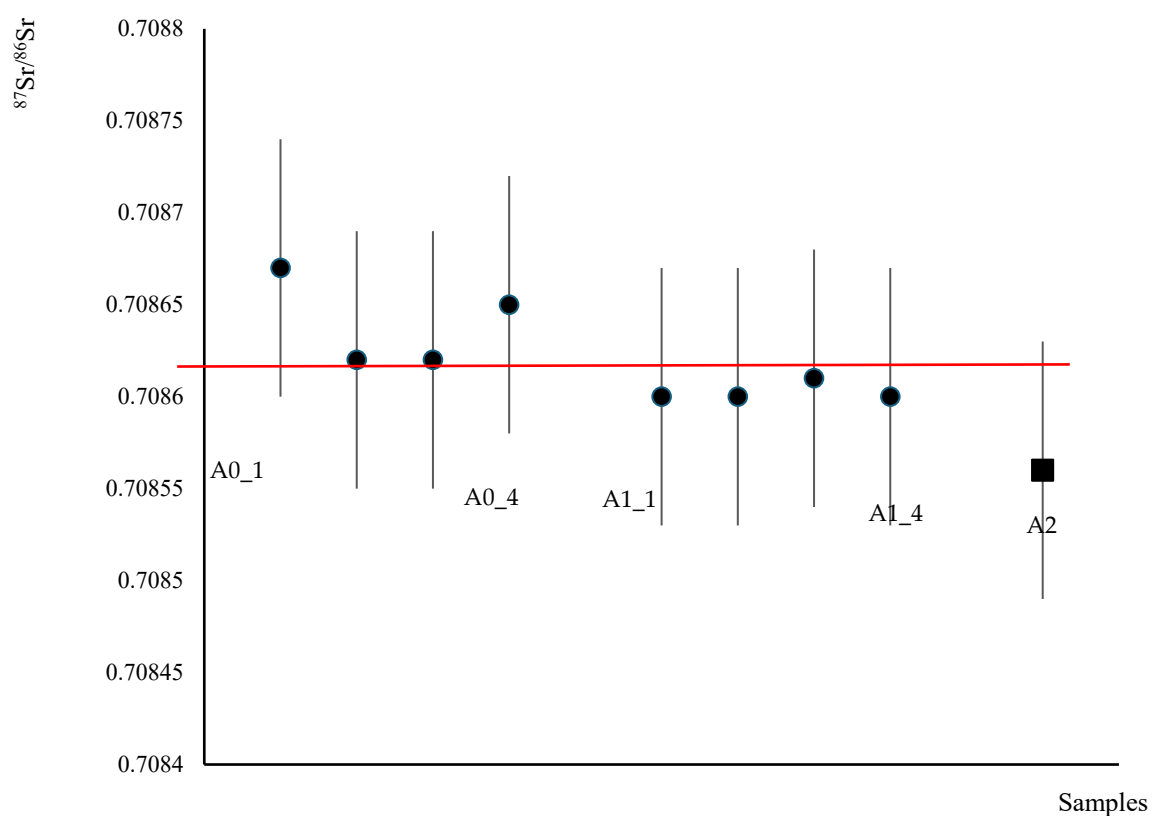


Figure S4. $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratio values determined on the hemp pieces (black circular indicator) and on the A2 fiber sample (square indicator). The vertical lines denote the uncertainty value, $u = 2sd$, associated with determinations equal to ± 0.00005 for the series (A0_1-4 and A1_1-4) and ± 0.00007 for the A2 fiber sample.

Table S7. Multi collector ICP-MS operating parameters for the $^{87}\text{Sr}/^{86}\text{Sr}$ ratio measurements.

Parameter	Sr wet plasma
RF power (W)	1245
Gas flow rate (L min^{-1})	Sample gas: 0.95 – 1.05 Auxiliary gas: 1.00 Cooling gas: 16
Sample/Skimmer cone	Ni
Injector	Sapphire
Spray chamber	Cyclonic + Scott type
Nebulizer	PFA micro flow self-aspirating
Faraday Cup configuration - amplifiers	L4 — L3 – $^{83}\text{Kr} - 10^{12}$ L2 – $^{84}\text{Sr} - 10^{12}$ L1 – $^{85}\text{Rb} - 10^{12}$ C – $^{86}\text{Sr} - 10^{11}$ H1 – $^{87}\text{Sr} - 10^{11}$ H2 – $^{88}\text{Sr} - 10^{11}$ H3 — H4 —
Control Cup for peak center	C – ^{86}Sr
Mass analyzer pressure (mbar)	$< 10^{-8}$
Background/baseline determination	4 % (v/v) HNO_3
Sample uptake rate ($\mu\text{L min}^{-1}$)	100
Uptake time (s)	300
Idle time (s)	10
Washing time (s)	100
Number of blocks	1
Number of cycles	100
Integration time (s)	8.839
Sensibility (V ppm^{-1})	> 70 for ^{88}Sr
Blank intensity range (mV)	10 – 15 for ^{88}Sr