Biostimulant effects of *Chaetomium globosum* and *Minimedusa polyspora* culture filtrates on Cichorium intybus plant: growth performance and metabolomic traits

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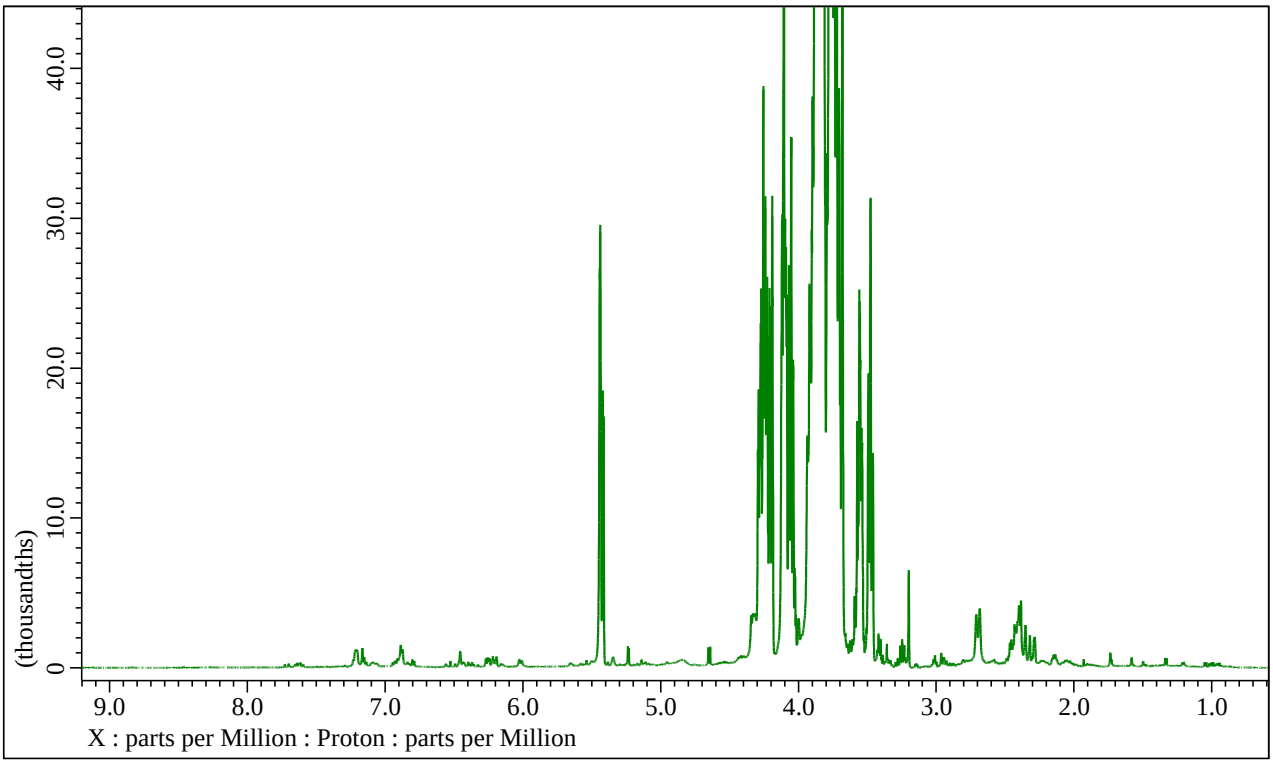
Supplementary Material

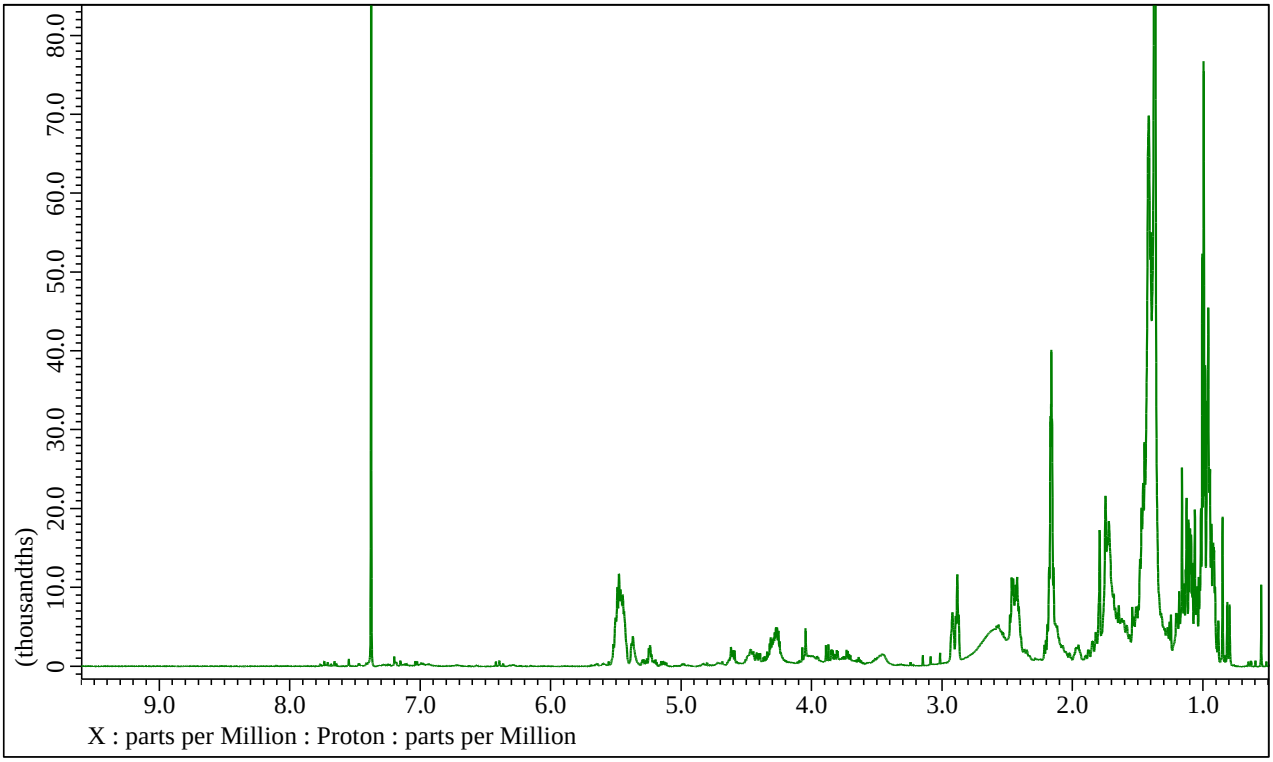
Supplementary Table 1. Filtrate composition assessed by NMR spectroscopy

Molecule	Amount (mg/100 ml)		
	MEB Control	*Chaetomium globosum* 205 filtrate	*Minimedusa polyspora* 503 filtrate
Leucine	1.01	0.00	1.34
Isoleucine	0.84	0.00	0.65
Valine	1.00	0.00	1.16
Threonine	1.72	0.00	1.61
Peptone (eq. Lys)	5.99	12.58	0.93
Alanine	1.90	1.80	4.27
Glutamate	0.77	0.00	0.47
GABA	1.29	0.00	0.98

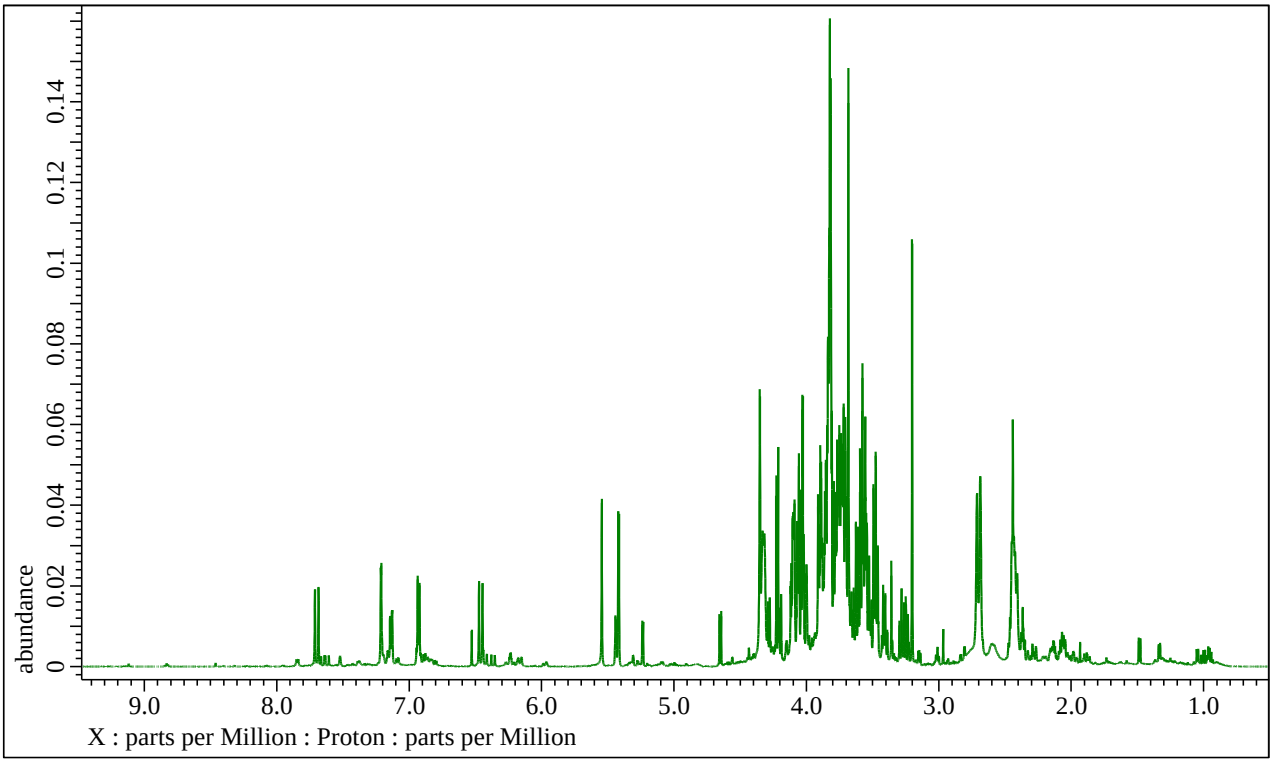
Lysine	2.93	0.00	5.16
Tyrosine	0.72	0.00	0.61
Phenylalanine	1.68	0.00	1.89
Acetate	0.84	0.00	0.04
Fumarate	0.00	1.33	0.00
Formate	0.35	0.00	0.00
Maltose	1266.79	771.54	6.60
Glucose	149.65	101.69	1040.87
Fructose	2.77	1.63	2.13
Ethanol	0.98	17.20	6.26
Choline	0.40	0.00	0.57
AXP	0.00	0.00	1.88
GXP	0.00	0.00	1.56



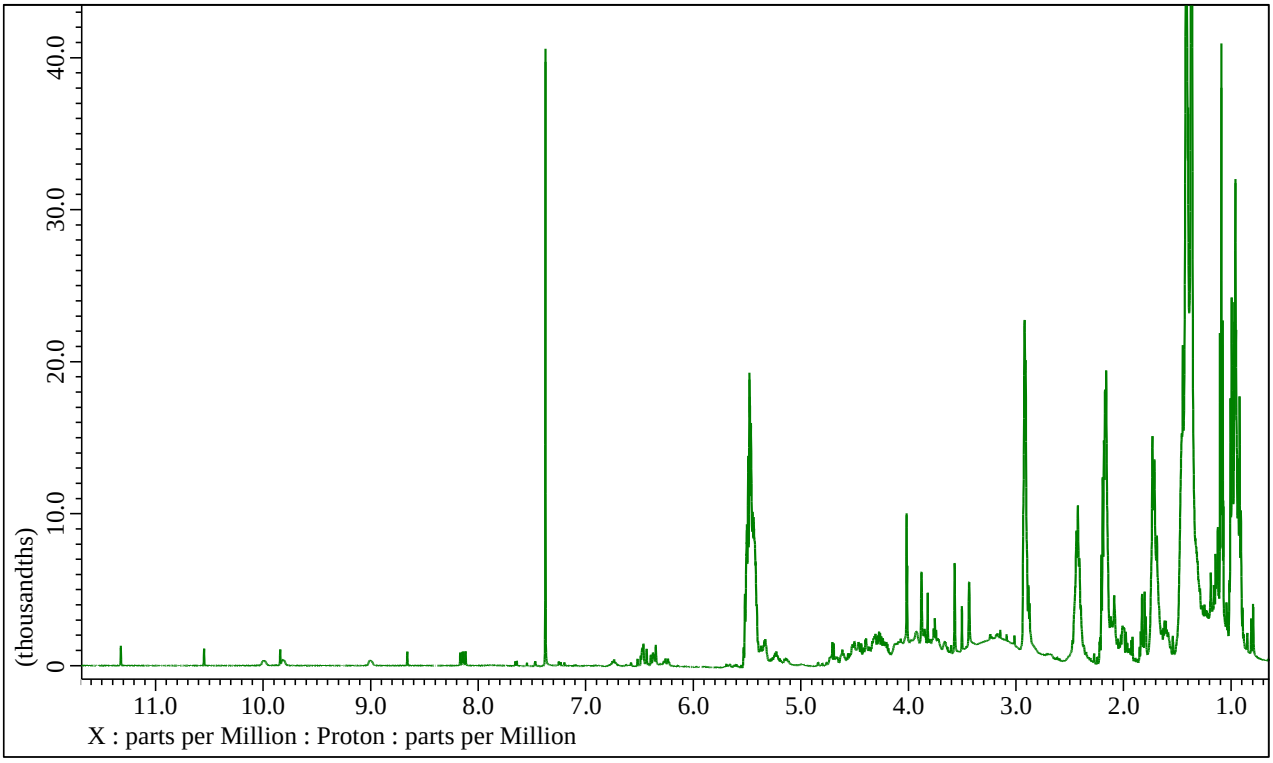
Supplementary Figure 1: ^{1}H spectrum of hydroalcoholic extract of chicory roots.



Supplementary Figure 2: ^{1}H spectrum of chloroform extract of chicory roots.



Supplementary Figure 3: ^{1}H spectrum of hydroalcoholic extract of chicory leaves.



Supplementary Figure 4: ^{1}H spectrum of chloroform extract of chicory leaves.

Supplementary Table 2. Table of resonance assignment

Compound	Assignment	^{1}H δ (ppm)	Multiplicity	^{13}C δ (ppm)	Portion
Organic acids					
Acetic acid (AA)	**CH_3**	**1.92**	**s**	25.98	L, R
3-hydroxybutyric acid (3HBA)	γ−CH_3 α,α'-CH β−CH	1.19 2.30-2.40 4.15	d dd m	24.5 49.12 69.01	R
Ascorbic acid (AscA)	CH_2-2' CH-1' **CH-5**	3.77 3.98 **4.49**	m m **d**	63.6 69.41 77.12	L
Caffeic Acid (CafA)	CH-1 CH-2 CH-3 CH-4 **CH-5**	7.19 7.07 6.96 7.31 **6.27**	d d dd d **d**	117.15 124.122 118.85 143.34 124.32	L
Chicoric Acid (ChA)	CH-1', 2' CH-8 **CH-7** CH-2	5.54 6.50 **7.72** 7.22	s d **d** d	54.23 115.95 117.56 118.90	L, R

	CH-5 CH-6	6.96 6.15	dd d	117.81 149.59	
Citric acid (CA)	**α,γ-CH** α',γ'-CH	**2.67** 2.71	**d** d	44.77 44.77	L
Chlorogenic acid (CGA)	CH_2-2' CH-3' CH-4' CH-5' **CH-8** CH-7 CH-2 CH-5 CH-6	2.02,2.17 5.33 3.88 4.23 **6.39** 6.94 7.12 7.19 7.65	m m dd m **d** d dd d d	40.11 40.14 75.43 72.93 73.82 117.56 118.90 117.81 149.59	L, R
Formic acid (FA)	**CH**	**8.46**	**s**	171.90	L, R
Fumaric acid (FumA)	**CH=CH**	**6.51**	**s**	137.94	L, R
Lactic acid (LA)	CH_3 CH	1.32 4.11	d q	22.95 77.04	L, R
Malic acid (MA)	**α- CH**	**4.31**	**dd**	69.33	R

	β.β'- CH	2.38,2.69	dd	40.86	
p-Hydroxybenzoate (pHBA)	**CH-2,6** CH-3,5	**7.80** 6.84	**d** d	132.96 116.21	L, R
Succinic acid (SA)	2 CH_2	2.39	s	36.31	L, R
<u>Amino acids</u>					
Alanine (Ala)	**β-CH_3** α- CH	**1.49** 3.80	**d** q	19.05 53.56	L, R
Aspartic acid (Asp)	β'-CH β-CH α-CH	2.68 2.72 3.91	dd dd m	39.31 39.31 55.09	L, R
Asparagine (Asn)	β'-CH **β-CH** α-CH	2.86 **2.89** 4.01	dd **dd** m	37.44 37.44 54.09	L, R
Glutamate (Glu)	γ- CH_2 **β,β-CH_2** α-CH	2.07 **2.35** 3.78	m **m** m	29.25 37.12 58.01	L, R

Glutamine (Gln)	γ- CH_2	2.11	m	29.31	L, R
	β,β-CH_2	**2.45**	**m**	34.02	
	α-CH	3.81	m	57.19	
Isoleucine (Ile)	δ-CH_3	0.95	t	13.85	L, R
	γ-CH_3	**1.02**	**d**	17.38	
	γ'-CH	1.25	m	27.01	
	γ''-CH	1.49	m	27.01	
	β-CH	1.99	m	38.71	
	α-CH	3.69	m	63.04	
Leucine (Leu)	**δ,δ'- CH_3**	**0.97**	**m**	23.85, 24.59	L, R
	γ-CH	1.72	m	26.81	
	β-CH_2	1.73	m	42.60	
	α-CH	3.74	m	56.21	
Lysine (Lys)	δ- CH_2	1.47	m	28.41	L
	γ- CH_2	1.69	m	30.51	
	β- CH_2	1.95	m	43.27	
	δ- CH_2	**3.03**	**t**	38.12	
	α- CH_2	3.78	t	57.32	

γ-aminobutyric acid (GABA)	**β-CH_2**	**1.95**	**t**	26.38	
	γ-CH_2	2.30	m	37.06	L, R
	α-CH_2	3.01	t	42.21	
Phenylalanine (Phe)	CH-2,6	7.32	d	130.3	
	CH-4	7.38	d	128.6	
	CH-3,5	**7.42**	**d**	130.3	L, R
	β-CH_2	3.27	m	37.1	
	α-CH	3.98	dd	56.8	
Pyroglutamic acid (PyrA)	γ- CH_2	2.01	m	33.25	
	β,β-CH_2	**2.45**	**m**	28.32	R
	α-CH	4.16	m	60.91	
Threonine (Thr)	**γ-CH_3**	**1.33**	**d**	22.15	
	α-CH	3.60	m	63.46	L, R
	β-CH	4.27	m	68.94	
Tryptophan (Trp)	CH-5	7.20	t	124.9	
	CH-6	7.27	t	127.9	
	CH-7	**7.53**	**d**	114.7	R
	CH-4	7.73	d	121.2	

Tyrosine (Tyr)	CH-2,6	7.22	d	130.0	L, R
	CH-3,5	**7.08**	**d**	117.0	
	β-CH_2	3.15	dd	37.1	
	α-CH	3.93	dd	56.8	
Valine (Val)	γ-CH_3	0.99	d	19.41	L, R
	γ'-CH_3	**1.05**	**d**	20.75	
	β-CH	2.29	m	31.89	
	α-CH	3.62	m	63.36	
Carbohydrates					
Amylose (Amy)	**CH-1**	**5.11**	**d**	99.10	L, R
	CH-2	3.33	m	72.49	
	CH-3	3.37	m	77.84	
	CH-4	3.42	m	70.67	
	CH-5	3.66	m	73.52	
	CH_2-6	3.63, 3.70	m	66.97	
α-Glucose (α-G)	**CH-1**	**5.25**	**d**	93.10	L, R
	CH-2	3.55	m	72.49	
	CH-3	3.72	m	73.84	

	CH-4	3.42	m	70.67	
	CH-5	3.84	m	72.52	
	CH_2-6	3.73, 3.90	m	96.97	
β-Glucose (β-G)	**CH-1**	**4.69**	**d**	96.97	L, R
	CH-2	3.26	m	75.17	
	CH-3	3.50	m	76.84	
	CH-4	3.42	m	70.70	
	CH-5	3.48	m	74.57	
	CH_2-6	3.74, 3.91	m	61.80	
Sucrose (S)	**GLC CH-1**	**5.42**	**d**	93.22	L, R
	CH-2	3.59	m	72.11	
	CH-3	3.79	m	73.54	
	CH-4	3.48	m	70.26	
	CH-5	3.85	m	73.38	
	CH_2-6	3.82	m	61.18	
	FRU CH_2-1’	3.69	m	62.44	
	C-2	\	\	104.85	
	CH-3’	4.22	m	77.45	
	CH-4’	4.06	m	75.04	
	CH-5’	3.90	m	82.44	

	CH_2-6	3.82	m	63.38	
Lipids & Sterols					
Linoleic acid (n-6 FA)	CH_3	0.86	t	14.06	L, R
	n-CH_2	1.36	m	29.37	
	C$\underline{H}_2$-CH=CH	2.04	m	29.45	
	CH=CH	5.37	m	130.29; 128.45	
	=CH-C$\underline{H}_2$-CH=	**2.76**	**t**	25.68	
	C$\underline{H}_2$-CH_2-CO_2^-	2.06	m	24.75	
	CH_2-CO_2^-	2.31	t	34.05	
Linolenic acid (n-3 FA)	CH_3	0.96	t	14.14	L, R
	n-CH_2	1.36	m	29.37	
	C$\underline{H}_2$-CH=CH	2.04	m	29.45	
	CH=CH	5.37	m	130.29; 128.45	
	=CH-C$\underline{H}_2$-CH=	**2.78**	**m**	25.83	
	C$\underline{H}_2$-CH_2-CO_2^-	2.06	m	24.75	
	CH_2-CO_2^-	2.31	t	34.05	
β-Sitosterol (β-ST)	CH_2-1	1.08, 1.85	m	37.19	L, R
	CH_2-2	1.51, 1.84	m	31.50	
	CHOH-3	3.52	m	71.81	

	CH_2-4	2.28	m	42.37	
	CH-6	5.34	m	121.79	
	CH_2-7	1.52, 1.98	m	31.98	
	CH-8	1.46	m	31.78	
	CH-14	0.99	m	56.74	
	CH_2-15	1.57	m	24.25	
	CH_2-16	1.26, 1.85	m	28.37	
	CH_3-18	**0.68**	**s**	12.20	
	CH_3-25	1.01	s	19.12	
Campsterol (Camp)	CH_2-1	1.08, 1.85	m	37.19	L, R
	CH_2-2	1.51, 1.84	m	31.50	
	CHOH-3	3.52	m	71.81	
	CH_2-4	2.28	m	42.37	
	CH-6	5.34	m	121.79	
	CH_2-7	1.52, 1.98	m	31.98	
	CH-8	1.46	m	31.78	
	CH-14	0.99	m	56.74	
	CH_2-15	1.57	m	24.25	
	CH_2-16	1.26, 1.85	m	28.37	
	CH_3-18	**0.70**	**s**	12.21	

	CH_3-25	1.01	s	19.12	
Miscellaneous Metabolites					
Adenosine phosphate (AXP)	CH-17’	4.18	ddd	67.40	L, R
	CH-17	4.24	ddd	67.40	
	CH-5	4.36	m	73.10	
	CH-4	4.58	dd	76.35	
	CH-2	**5.92**	**d**	89.33	
	CH-7	8.12	s	140.39	
Choline (Chn)	**$N(CH_3)_3$**	**3.20**	**S**	56.70	L, R
7-Hydroxycoumarin (HCou)	CH-3	6.34	d	115.45	R
	CH-4	**7.67**	**d**	143.21	
	CH-5	7.36	d	127.55	
	CH-6	7.09	dd	125.24	
	CH-8	7.13	d	117.03	
Trigonelline (Trg)	N-CH_3	4.42	s	51.1	L, R
	CH4	8.07	m	130.4	
	CH3,5	8.82	m	148.5	
	CH1	**9.11**	**s**	148.1	

Uracile (Ur)	**CH-5** CH-6	**5.92** 7.85	**d** d	103.7 146.3	L, R
Monoacylglycerol (MAG)	**CH_2** CH_2 CH	**3.65-3,55** 4.05-4.15 3.82	**dd** dd m	65.45 70.32 75.12	L, R
Phospholipids (PP)	CH **$2CH_2$**	**5.13-5.21** 4.15-4.29	bm dd	77.45 68.23	L, R
Triglycerids (TG)	CH **$2CH_2$**	**5.33** 4.15-4.29	m dd	74.64 65.93	A
Triterpenes (TP)	CH-5 CH-9 CH_2-11 CH-12 **CH-18** CH_2-22	0.87 1.65 1.94 5.49 **2.54** 1.97	m t m t **d** t	55.19 48.34 23.9 125.71 53.22 37.43	L, R
Carotenoids (Crt)	CH_2-2,2’ CH_2-3,3’ CH_2-4,4’ CH-7,7’ CH-8,8’ CH-10,10’ **CH-11,11’**	1.47 1.62 2.02 6.15 6.14 6.14 **6.68**	m m m d d d **m**	39.62 19.27 33.18 126.68 137.78 130.88 125.04	L

	CH-12,12’	6.35	d	137.26	
	CH-14,14’	6.25	d	132.45	
	CH-15,15’	6.63	m	130.02	
	CH_3-16,16’,17,17’	1.03	s	29.01	
	CH_3-18,18’	1.72	s	21.77	
	CH_3-19,19’	1.97	s	12.81	
Xanthophyl (Xant)	CH-2,2’	1.47	m	39.62	R
	CH-3,3’	1.62	m	19.27	
	CH-4	2.02	m	33.18	
	CH-4’	5.45	bs	123.18	
	CH-7,7’	6.15	d	126.68	
	CH-8,8’	6.14	d	137.78	
	CH-10,10’	6.14	d	130.88	
	CH-11,11’	6.68	m	125.04	
	CH-12,12’	6.35	d	137.26	
	CH-14,14’	6.25	d	132.45	
	CH-15,15’	**6.83**	**m**	130.02	
	CH_3-16,16’,17,17’	1.03	s	29.05	
	CH_3-18,18’	1.72	s	21.77	

	CH_3-19,19’ CH_3-20,20’	1.97 1.96	s s	12.81 12.84	
Chlorofyll a (Chl A)	CH-5 CH-10 **CH-20**	9.57 9.22 **8.41**	s s **s**	137.6 108.2 93.4	L
Chlorofyll b (Chl B)	**CHO-7** CH-10	**11.22** 9.72	**s** s	178.2 109.4	L

In bold are evidenced the resonances chosen for metabolite quantification; s: singlet, d: doublet, t: triplet, q: quadruplet, dd: doublet of doublets, m: multiplet, bm: broad multiplet; L: leaves, R: roots

Supplementary Table 3. Phytochemical composition of chicory roots.

Molecule	Amount (mg / 100 g)		
	MEB Control	*Chaetomium globosum* 205	*Minimedusa polyspora* 503
Leucine	0.19 ± 0.01	0.21 ± 0.03	0.23 ± 0.03
Isoleucine	0.4 ± 0.05	0.43 ± 0.08	0.45 ± 0.07
Valine	0.48 ± 0.06	0.64 ± 0.14	0.62 ± 0.09
Threonine	0.74 ± 0.11	1.03 ± 0.21	1.1 ± 0.25
Alanine	0.06 ± 0.05	0.36 ± 0.07	0.15 ± 0.09
Glutamate	5.64 ± 0.79	6.96 ± 0.93	7.21 ± 1.14
Glutamine	8.17 ± 1.64	12.33 ± 2.55	10.97 ± 2.20
Pyroglutamate	51.9 ± 6.69	58.38 ± 10.62	52.42 ± 8.45
Asparagine	1.46 ± 0.38	6.11 ± 3.42	3.14 ± 1.28
GABA	4.43 ± 0.56	4.17 ± 0.63	4.43 ± 0.5
Tyrosine	0.84 ± 0.44	0.93 ± 0.35	0.73 ± 0.17
Phenylalanine	0.51 ± 0.06	0.68 ± 0.06	0.63 ± 0.08
Tryptophan	0.36 ± 0.11	0.19 ± 0.07	0.11 ± 0.06
3-OHButyrate	0.41 ± 0.03	0.54 ± 0.04	0.55 ± 0.05
Acetate	0.18 ± 0.04	0.16 ± 0.02	0.16 ± 0.02

Malate	2.93 ± 1.58	1.72 ± 0.49	1.76 ± 0.33
Chicoric acid	7.91 ± 3.18	16.74 ± 2.16	12.82 ± 2.62
Chlorogenic acid	2.33 ± 0.92	4.31 ± 0.40	3.59 ± 0.99
Fumarate	0.61 ± 0.20	0.51 ± 0.15	0.42 ± 0.16
4-OH-Benzoate	0.26 ± 0.02	0.37 ± 0.06	0.4 ± 0.07
Formate	0.15 ± 0.02	0.12 ± 0.02	0.13 ± 0.02
Glucose	26.06 ± 3.47	25.26 ± 2.07	22.31 ± 4.84
Sucrose	221.65 ± 48.06	248.54 ± 45.89	226.44 ± 27.73
Amylose	325.09 ± 75.62	268.99 ± 49.84	336.92 ± 52.54
β-Sitosterol	3.39 ± 0.14	2.35 ± 0.12	2.64 ± 0.49
Campesterol	3.44 ± 0.24	2.9 ± 0.17	2.55 ± 0.29
Oleic acid	20.8 ± 2.34	20.82 ± 1.5	23.08 ± 4.87
Linoleic acid	18.29 ± 0.63	16.1 ± 0.93	15.7 ± 2.53
Linolenic acid	5.41 ± 0.21	3.99 ± 0.2	3.63 ± 0.54
Triterpenes (eq. Oleanoic acid)	3.97 ± 0.59	4.48 ± 3.3	0.9 ± 0.11
Glycerol of monoacylglycerols	0.24 ± 0.04	0.41 ± 0.05	0.37 ± 0.03
Glycerol of phospholipids	4.52 ± 0.52	2.14 ± 0.19	1.76 ± 0.49
Choline	2.81 ± 0.23	3.15 ± 0.36	3.4 ± 0.43
Uracil	1.35 ± 0.88	0.66 ± 0.14	0.86 ± 0.14

Adenosine-phospate	0.58 ± 0.09	0.64 ± 0.13	0.78 ± 0.19
Trigonelline	0.11 ± 0.03	0.08 ± 0.01	0.07 ± 0.01
Xantophyl (eq. Luteolin)	0.28 ± 0.02	0.23 ± 0.02	0.2 ± 0.03
7-OH-Coumarin	0.39 ± 0.06	0.31 ± 0.08	0.34 ± 0.06
Aldehyde (eq. Hexanal)	0.1 ± 0.01	0.09 ± 0.01	0.09 ± 0.01

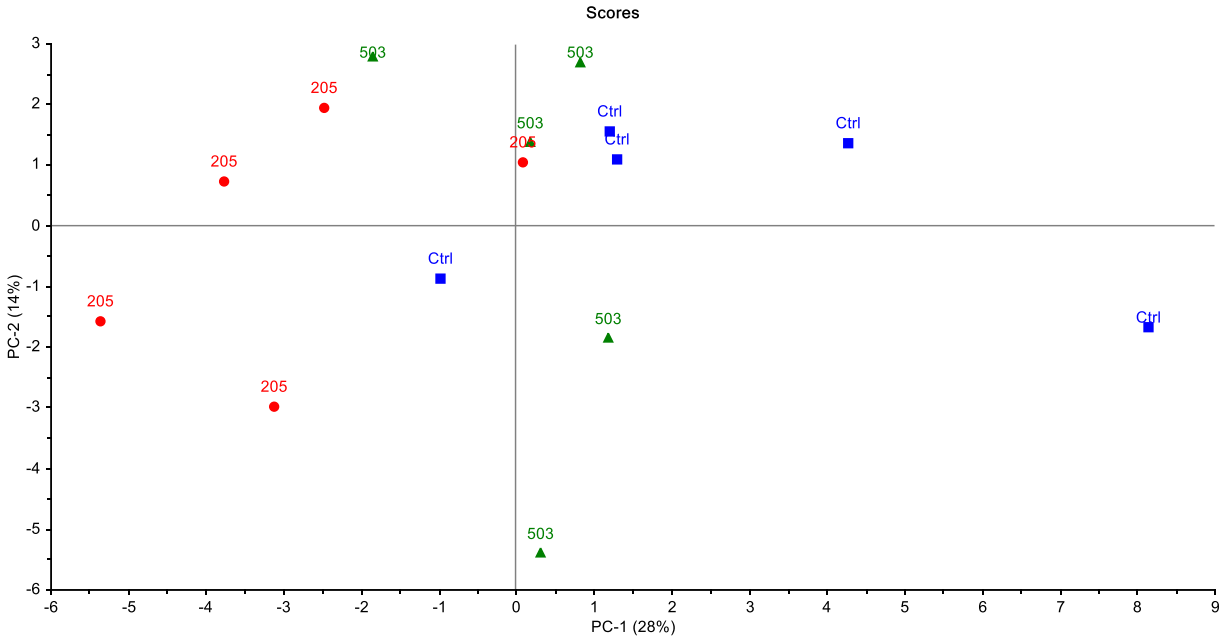
Supplementary Table 4: Phytochemical composition of chicory leaves.

Molecule	Amount (mg / 100 g)		
	MEB Control	*Chaetomium globosum* 205	*Minimedusa polyspora* 503
Leucine	0.46 ± 0.03	0.32 ± 0.07	0.42 ± 0.04
Isoleucine	0.54 ± 0.05	0.34 ± 0.08	0.47 ± 0.03
Valine	0.7 ± 0.04	0.45 ± 0.06	0.64 ± 0.03
Threonine	0.84 ± 0.06	0.71 ± 0.04	0.85 ± 0.09
Alanine	1.18 ± 0.19	0.94 ± 0.11	1.01 ± 0.10
Glutamate	4.13 ± 0.99	3.77 ± 1.15	4.36 ± 0.96
Asparagine	3.74 ± 0.54	3.75 ± 0.35	4.67 ± 0.79
GABA	2.6 ± 1.42	1.84 ± 0.83	1.75 ± 0.65
Lysine	2.55 ± 0.26	2.46 ± 0.3	3.25 ± 0.76
Tyrosine	0.73 ± 0.18	0.93 ± 0.17	0.56 ± 0.22

Phenylalanine	0.54 ± 0.1	0.4 ± 0.09	0.7 ± 0.24
Acetate	0.25 ± 0.03	0.17 ± 0.04	0.13 ± 0.03
Citrate	181.88 ± 35.51	128.03 ± 13.23	140.6 ± 13.03
Ascorbate	6.30 ± 1.42	10.1 ± 2.49	8.61 ± 3.52
Caffeic acid	2.26 ± 0.63	3.12 ± 1.70	1.26 ± 0.64
Chlorogenic acid	45.62 ± 7.09	50.51 ± 10.78	46.07 ± 19.3
Fumarate	1.97 ± 0.38	1.37 ± 0.15	1.95 ± 0.21
Chicoric acid	11.56 ± 3.72	12.94 ± 5.98	12.42 ± 4.58
4-OH-Benzoate	0.39 ± 0.04	1.27 ± 0.49	0.64 ± 0.09
Formate	0.23 ± 0.03	0.2 ± 0.02	0.17 ± 0.04
Glucose	13.09 ± 2.8	16.63 ± 4.41	13.57 ± 4.64
Sucrose	73.07 ± 7.63	112.66 ± 22.12	79.2 ± 11.77
Amylose	8.92 ± 3.05	24.64 ± 15.42	6.43 ± 1.33
β-Sitosterol	3.62 ± 0.23	2.7 ± 0.27	2.82 ± 0.19
Campesterol	1.91 ± 0.13	1.02 ± 0.16	0.93 ± 0.11
Oleic acid	26.16 ± 2.76	18.81 ± 1.38	23.25 ± 1.22
Linoleic acid	4.1 ± 0.59	4.11 ± 0.49	5.39 ± 0.66
Linolenic acid	64.91 ± 7.4	54.51 ± 4.54	66.56 ± 1.71
Triterpenes (eq. Oleanoic acid)	7.36 ± 4.08	0.75 ± 0.4	3.06 ± 0.79
Glycerol of monoacylglicerol	1.14 ± 0.48	2.49 ± 0.56	1.54 ± 0.39
Glycerol of phospholipids	2.01 ± 0.73	1.02 ± 0.46	2.01 ± 0.11

Choline	5.08 ± 0.5	4.78 ± 0.61	4.80 ± 0.20
Uracil	0.42 ± 0.19	0.17 ± 0.05	0.11 ± 0.07
Adenosine-phospate	0.64 ± 0.16	0.52 ± 0.09	0.72 ± 0.16
Trigonelline	0.5 ± 0.11	0.42 ± 0.06	0.35 ± 0.07
Xantophyl (eq. Luteolin)	3.58 ± 1.16	3.26 ± 0.34	4.15 ± 0.23
Carotenoids	3.12 ± 0.46	3.03 ± 0.29	3.53 ± 0.07
Chlorophyll a	40.98 ± 5.14	3.79 ± 0.67	7.07 ± 0.47
Chlorophyll b	9.96 ± 1.21	0.05 ± 0.02	5.18 ± 0.39

Supplementary Figure 5. PCA on the whole NMR data set obtained from leaf extracts



Supplementary Figure 6. PCA on the whole NMR data set obtained from root extracts