Pollination, phytochemistry and food on table: how and whether environmental health can impact on human nutrition

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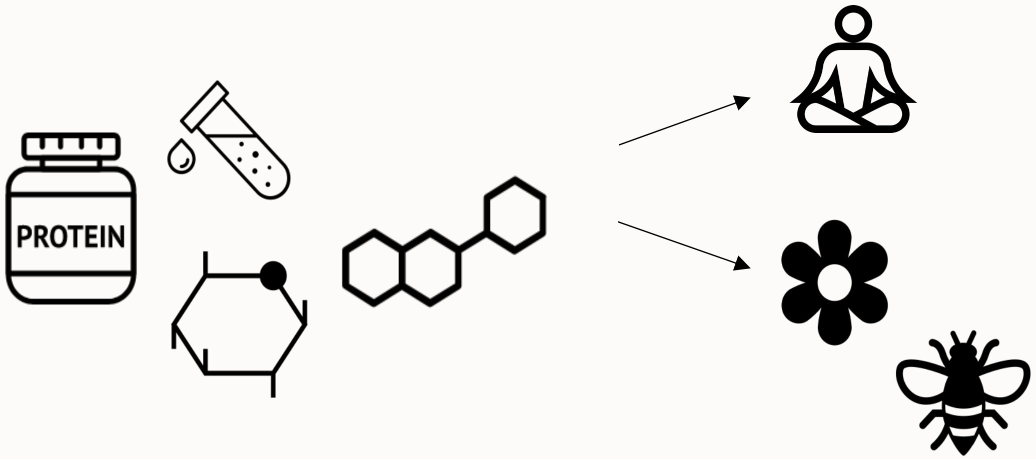
19th December 2022

NUTRITIONAL ECOLOGY AND PHYTOCHEMISTRY

NUTRIENTS PLAY AN IMPORTANT ROLE NOT ONLY FOR HUMAN HEALTH BUT ALSO FOR ECOSYSTEM INTEGRITY



INVESTIGATION WORKFLOW AT OUR LAB:

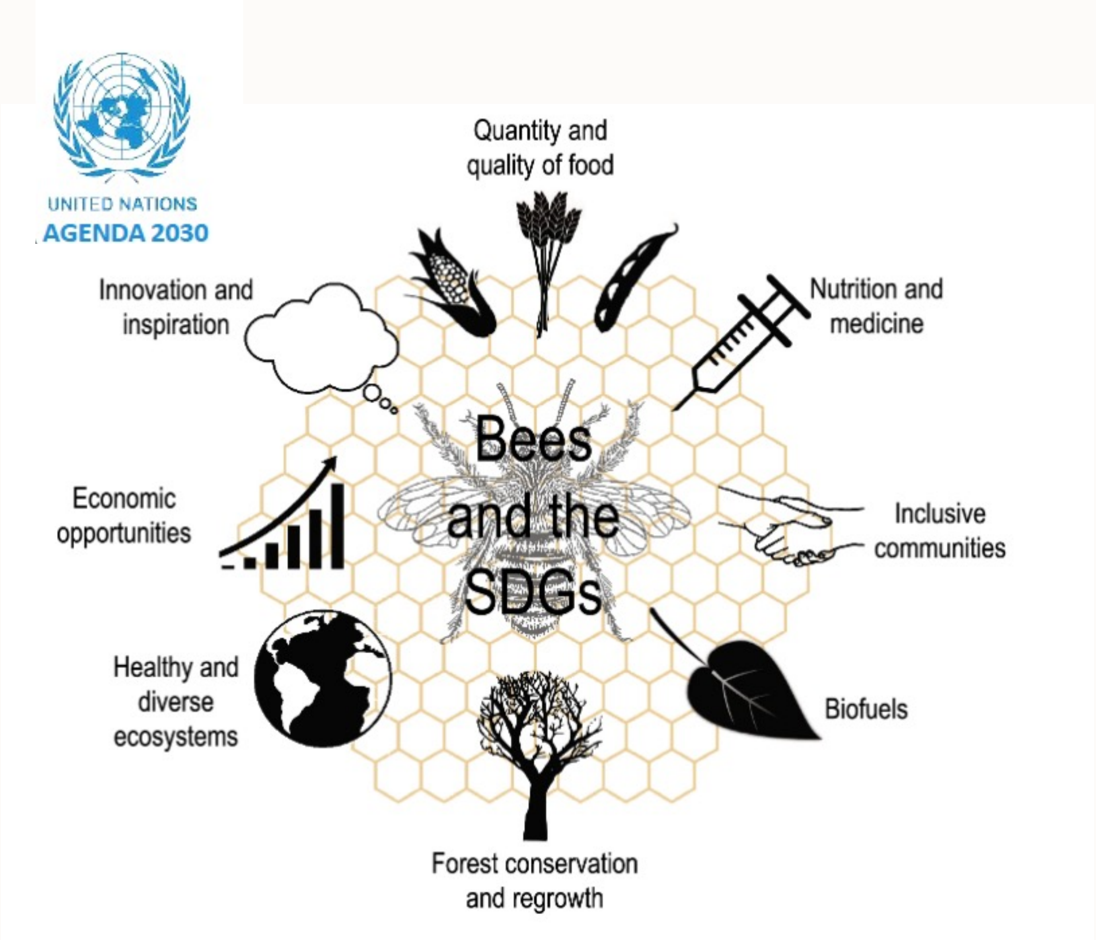
RESOURCE QUALITY

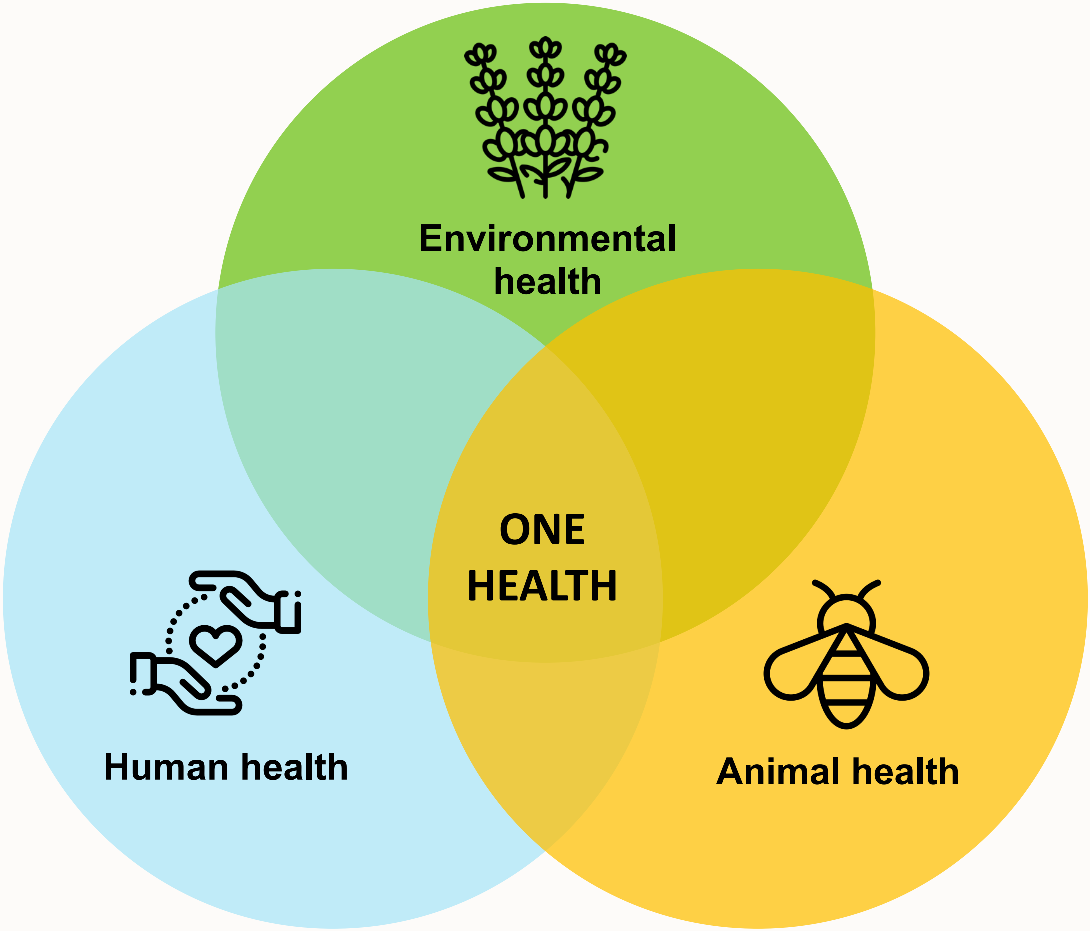
POLLINATORS HEALTH

ECOSYSTEM SERVICES

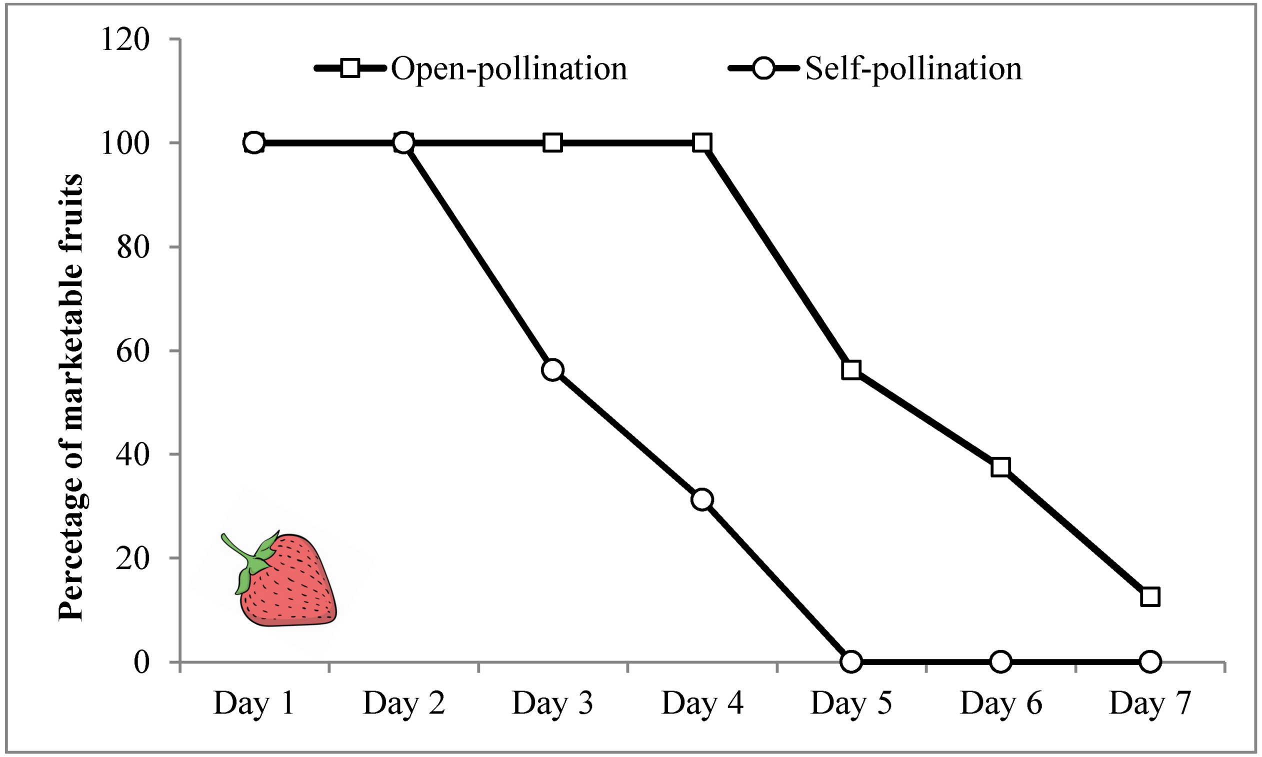
FOOD QUALITY

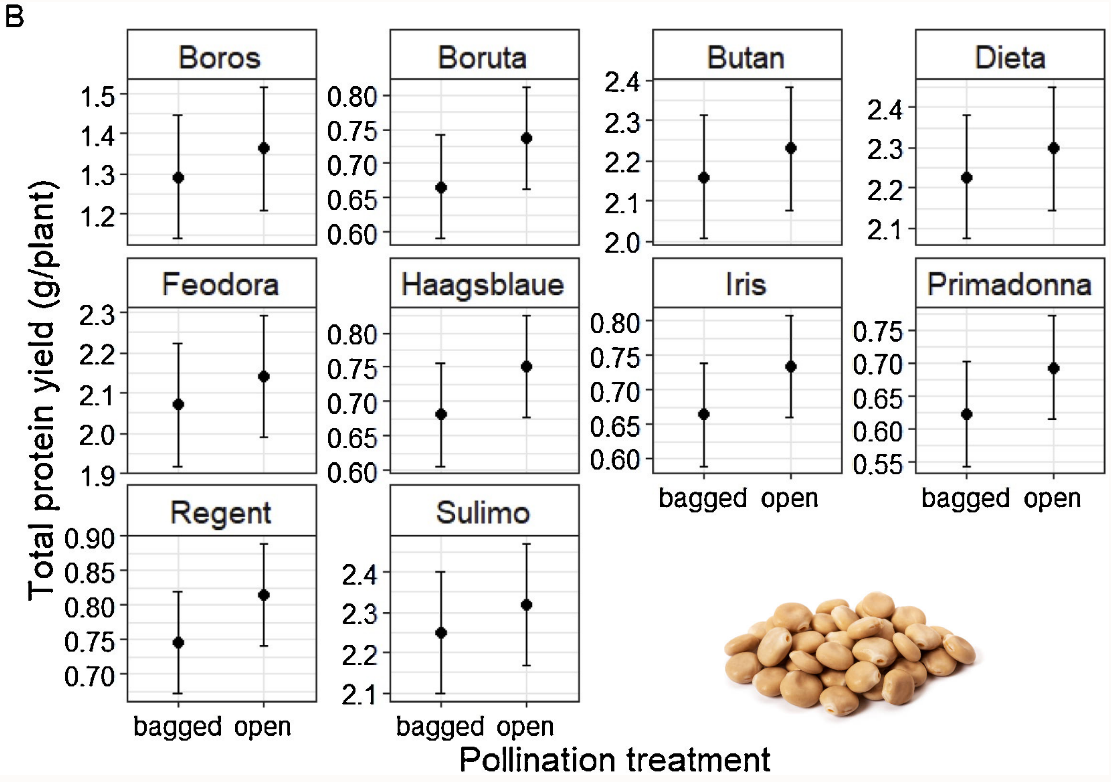
POLLINATORS AND AGENDA 2030: THE *ONE HEALTH* CONCEPT





POLLINATORS SHAPE CROP YIELD AND QUALITY

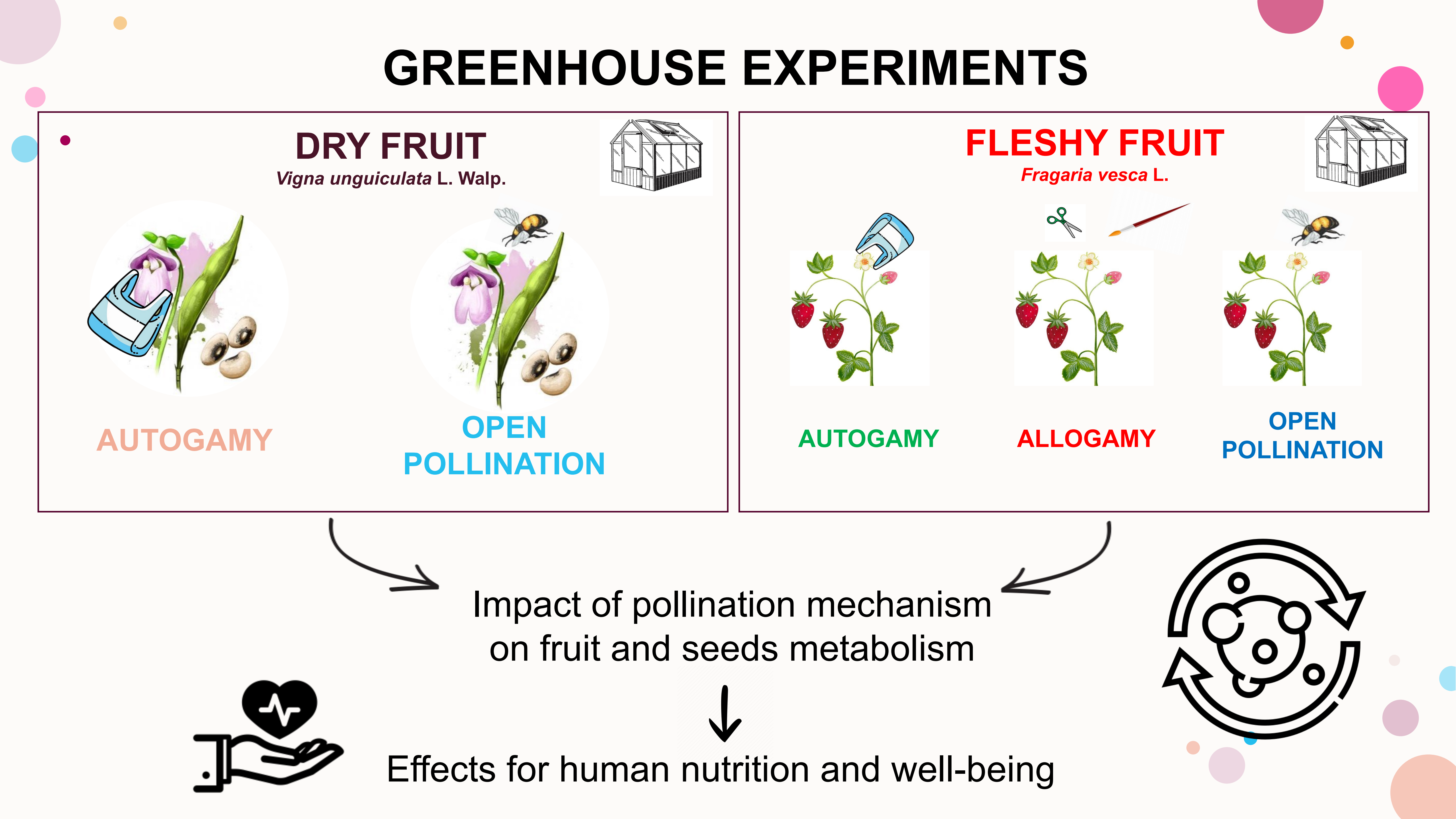




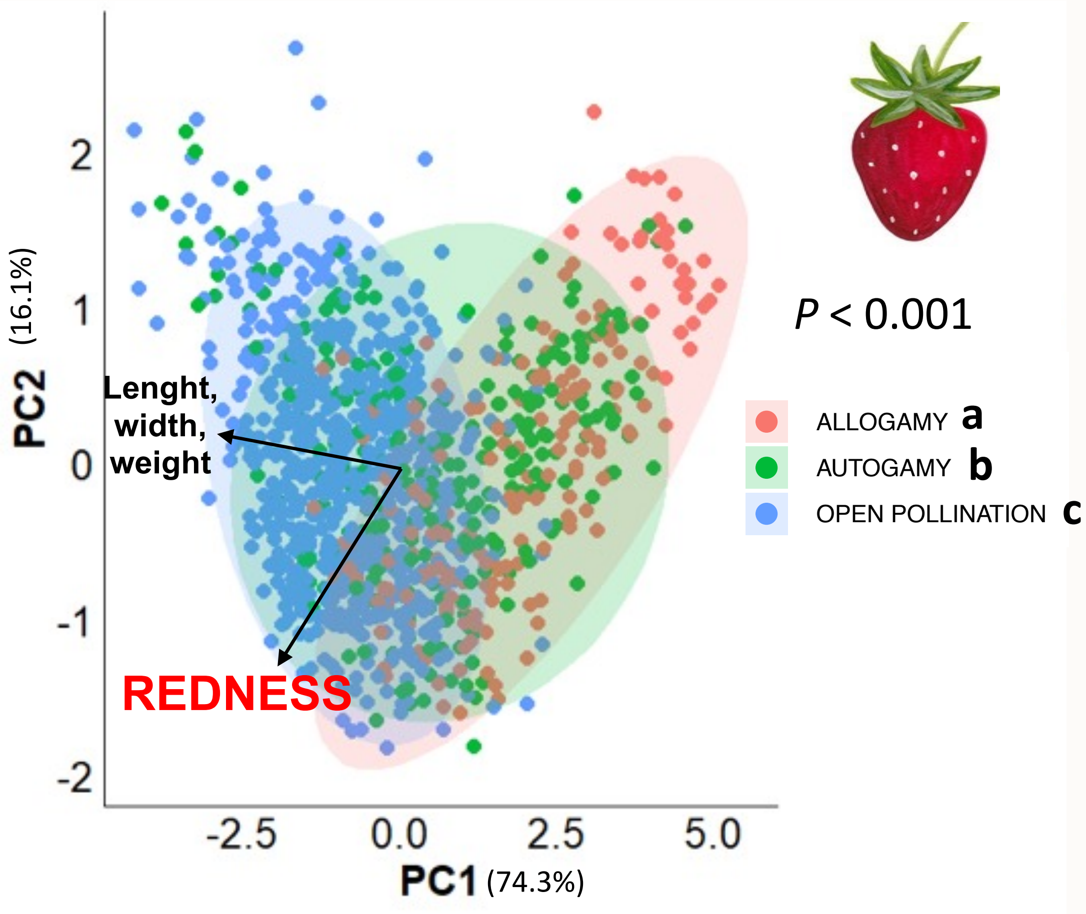
Anees et al., 2022 «Impact of bee and fly pollination on Physical and biochemical properties of strawberry fruit» *Horticulturae*, 1-10

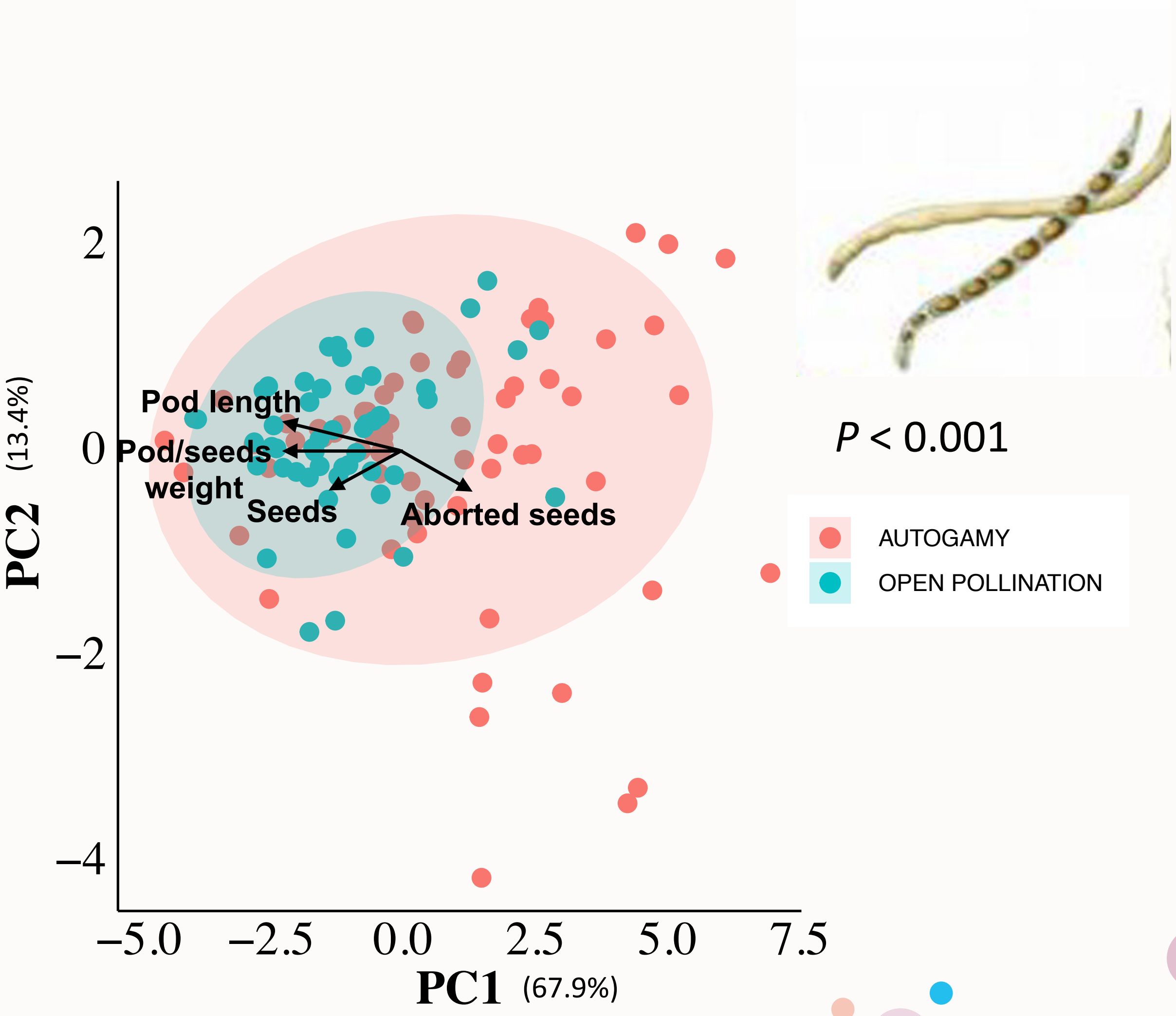
Fijen et al., 2021 «Pollination increases white and narrow-leaved lupin protein yields but not all crop visitors contribute to pollination» *Agr Ecosyst Environ*, 1-7

LACK OF INFORMATION ABOUT FUNCTIONAL FOOD ASPECTS (e.g., nutraceutical value)

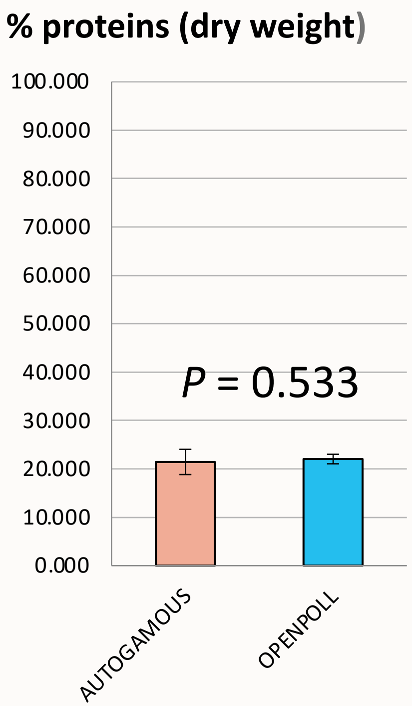

GREENHOUSE EXPERIMENTS
DRY FRUIT
Vigna unguiculata L. Walp.
AUTOGAMY
OPEN POLLINATION
FLESHY FRUIT
Fragaria vesca L.
AUTOGAMY
ALLOGAMY
OPEN POLLINATION
Impact of pollination mechanism on fruit and seeds metabolism
Effects for human nutrition and well-being

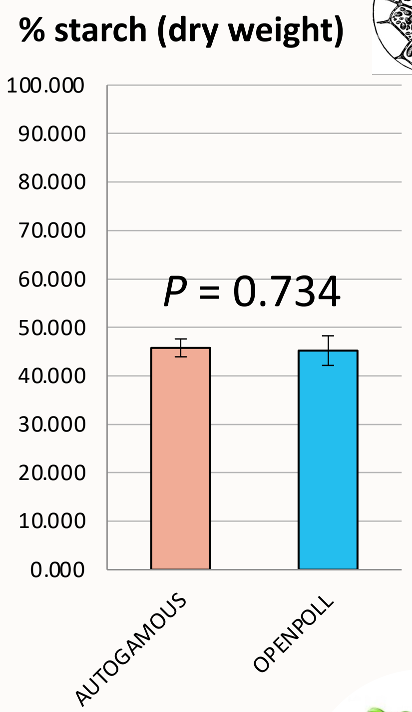
MORPHOLOGICAL TRAITS (season 2021)

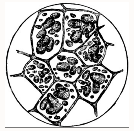


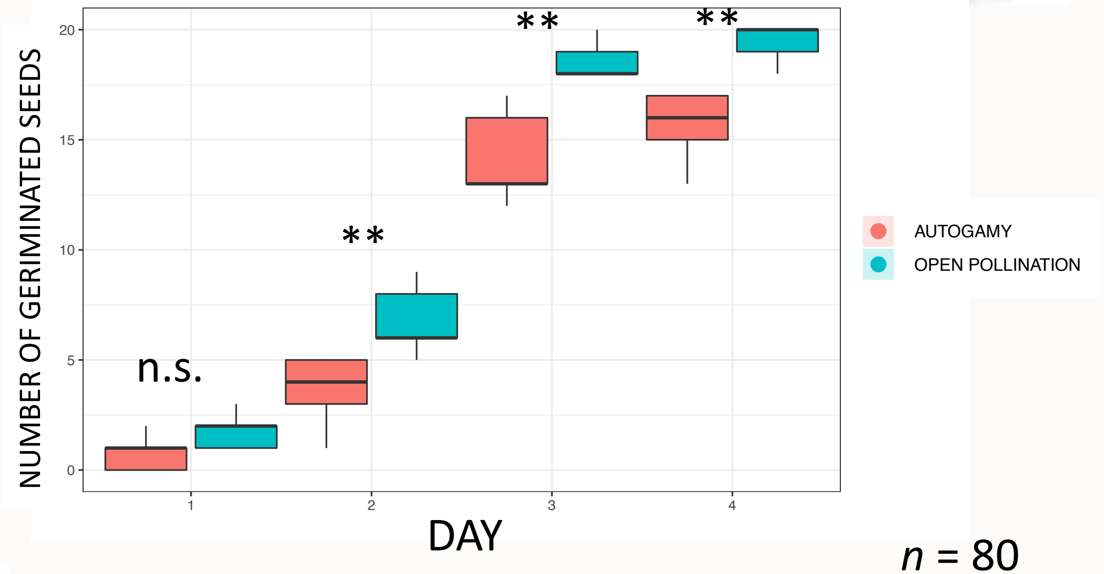


PRIMARY METABOLISM AND GERMINATION IN V. UNGUICULATA (2021)









n = 80

AUTOGAMY

OPEN POLLINATION

HRMS ANALYSES PROCEDURE

EXTRACTION PROCEDURE

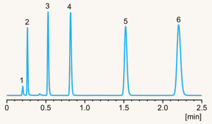
0.5 g dry powder agitated for 15 min in 10 mL of a hydro-alcoholic solvent (MeOH 70% v/v pH 3.5) twice.

ISOLATION OF PIGMENTS

Solid Phase Extraction (SPE) through C_{18} column.
Elution with EtOH:H_2O 1:1 v/v + 0.1% HCOOH

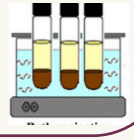
HPLC-PDA-QTOF-MS^n

<u>Column:</u> Zorbax SB-C18 (100 x 2.1 mm) 3.5 µm
<u>Mobile Phases:</u> A: H_2O + 0.1% HCOOH, B: MeCN + 0.1%HCOOH.
Gradient elution.



EXTRACTION PROCEDURE

0.5 g dry powder ultrasonicated for 10 min in 10 mL of a hydro-alcoholic solvent (EtOH 50% v/v) three times.



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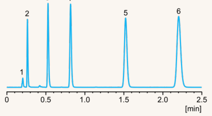
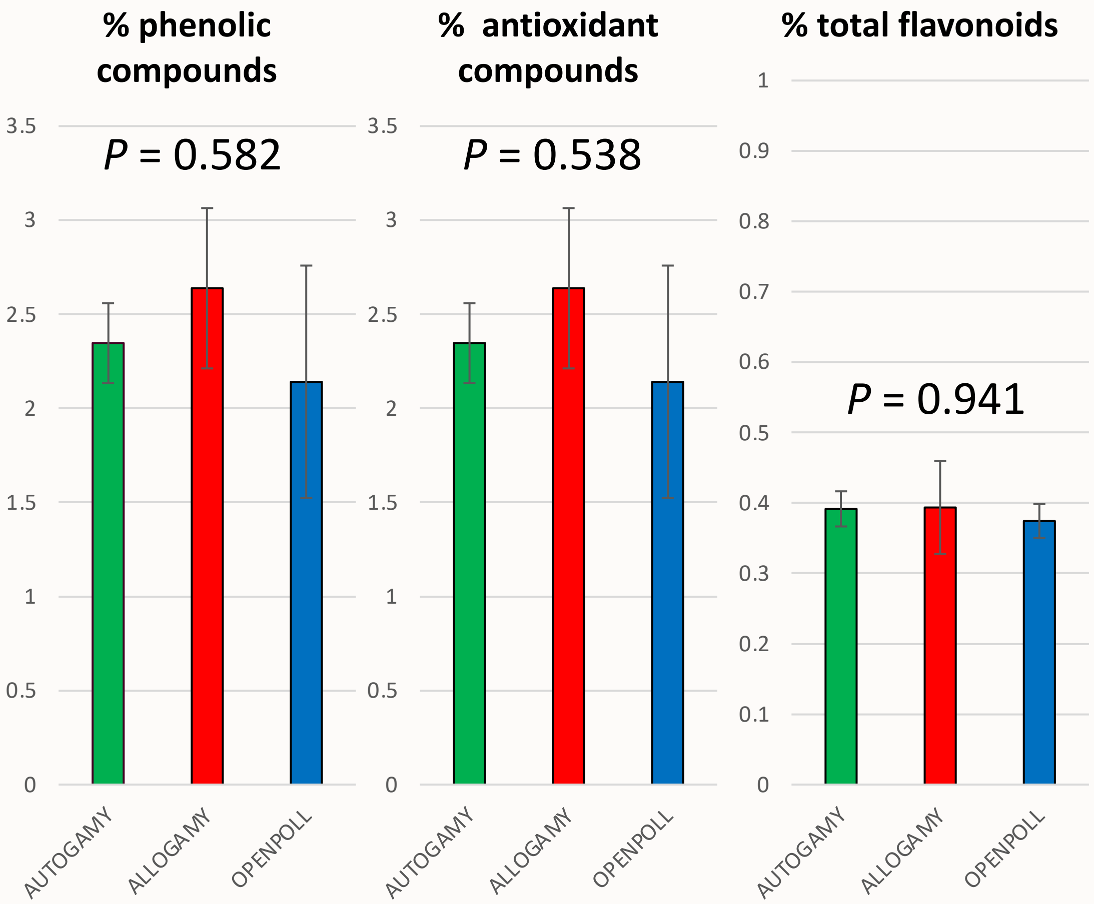


TOTAL ANTIOXIDANTS COMPOSITION

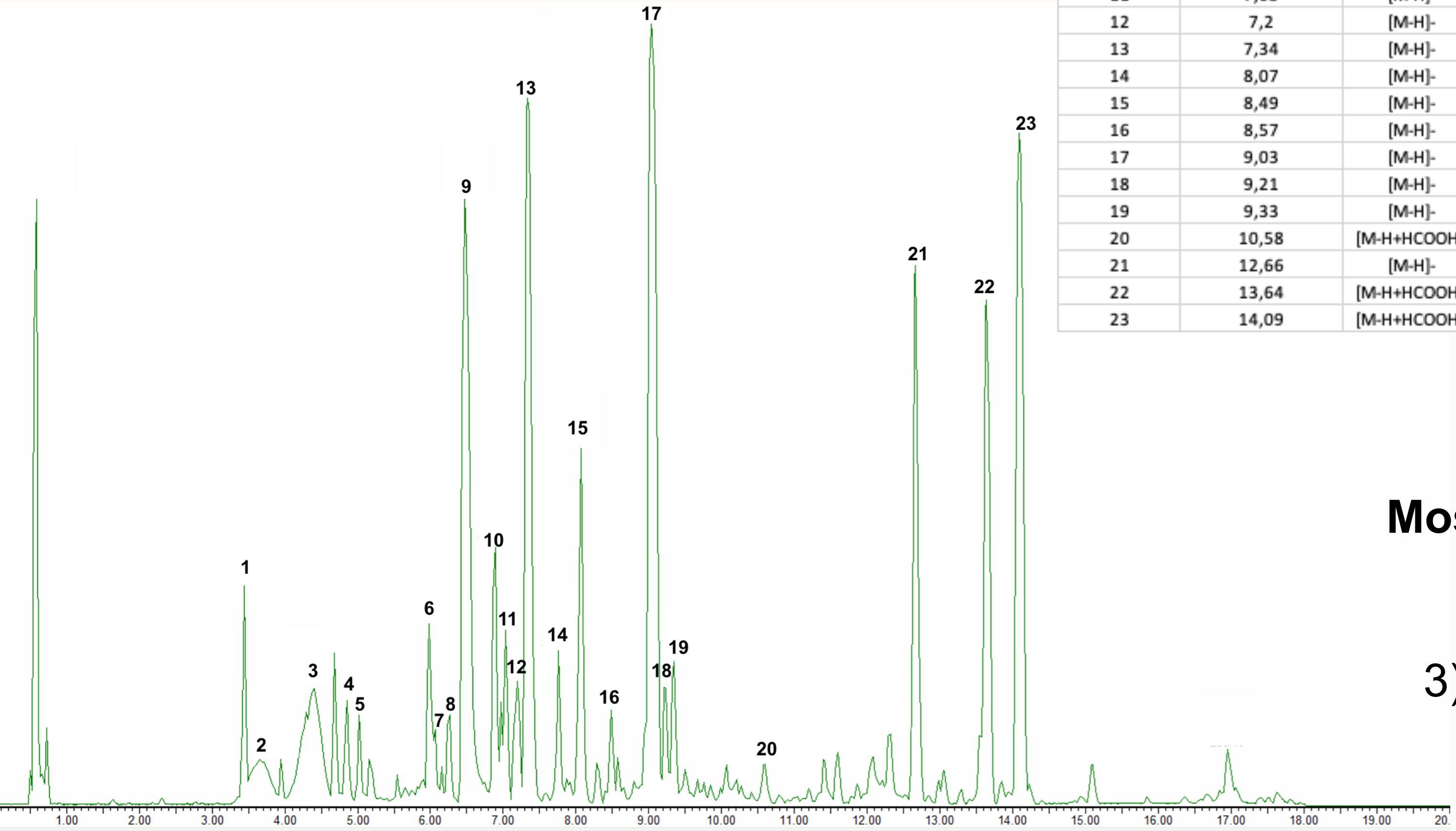


NO SIGNIFICANT DIFFERENCES IN TERMS OF OVERALL ANTIOXIDANT COMPOUNDS BUT NO INFORMATION AT THE METABOLITES LEVEL

METABOLITES COMPOSITION

Compounds occurring in the enriched fraction were tentatively identified by comparison with available literature

Peak number	Retention time	Ion current	Precursor ion	Fragments	Tentative identification	References
1	3,4	[M-H]-	289	245, 123, 109	(-)Epicatechin	Del Bubba, 2012
2	3,68	M+	449	287	Cyanidin hexoside	Del Bubba, 2012
3	4,39	M+	433	271	Pelargonidin hexoside	Del Bubba, 2012
4	4,87	M+	563	463, 301, 286	Peonidin methyl malonyl hexoside	Del Bubba, 2012
5	5,01	[M-H]-	449	269, 193, 165	Ferulic acid hexose derivative	Sun et al., 2014
6	5,99	[M-H]-	447	301, 300	Ellagic acid rhamnoside	Del Bubba, 2012
7	6,07	M+	519	271	Pelargonidin-malonylglucoside	Del Bubba, 2012
8	6,2	[M-H]-	447	300	Ellagic acid rhamnoside	Sun et al., 2014
9	6,46	[M-H]-	655	301, 229, 201, 129	Ellagic acid derivative	Sun et al., 2014
10	6,88	[M-H]-	521	359	Tetramethylellagic acid hexose	Sun et al., 2014
11	7,03	[M-H]-	463	300, 179, 151	Quercetin-3-O-glucoside	Sun et al., 2014
12	7,2	[M-H]-	521	359, 344	Tetramethylellagic acid hexose	Sun et al., 2014
13	7,34	[M-H]-	435	305, 285	Taxifolin 3-Oarabinofuranoside	Sun et al., 2014
14	8,07	[M-H]-	447	327,285,255,227	Kaempferol 3-O-glucoside	Sun et al., 2014
15	8,49	[M-H]-	477	315,314,299,285,271,257,243	Methylellagic acid hexose	Sun et al., 2014
16	8,57	[M-H]-	519	315, 300	Methylellagic acid acetyl hexoside	Sun et al., 2014
17	9,03	[M-H]-	461	315, 300	Methylellagic acid rhamnoside	Sun et al., 2014
18	9,21	[M-H]-	489	447, 327, 285,255	Kaempferol acetyl hexoside	Del Bubba, 2012
19	9,33	[M-H]-	461	315, 300	Methylellagic acid rhamnoside	Sun et al., 2014
20	10,58	[M-H+HCOOH]-	711	503	Triterpene glycoside	Spinola et a., 2019
21	12,66	[M-H]-	593	447, 307, 285	Kaempferol 3-coumaroylglucoside	Sun et al., 2014
22	13,64	[M-H+HCOOH]-	695	487	Triterpene glycoside	Lorenço et al., 2021
23	14,09	[M-H+HCOOH]-	695	487	Triterpene glycoside	Lorenço et al., 2021

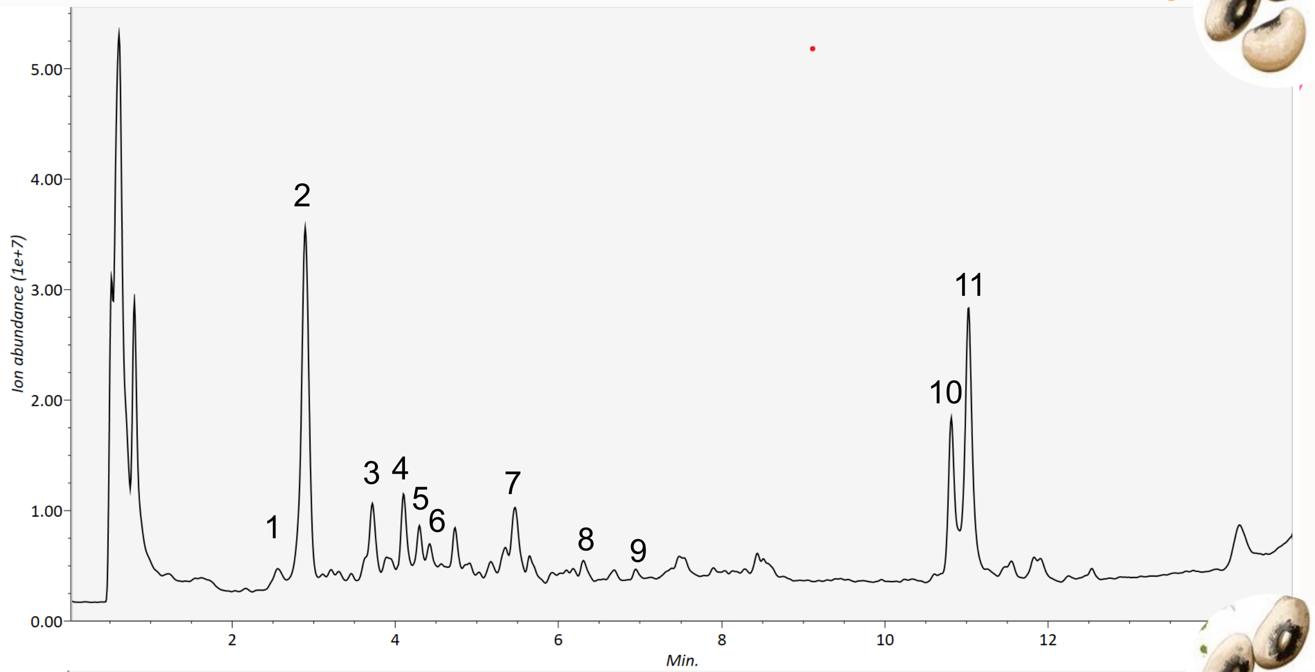


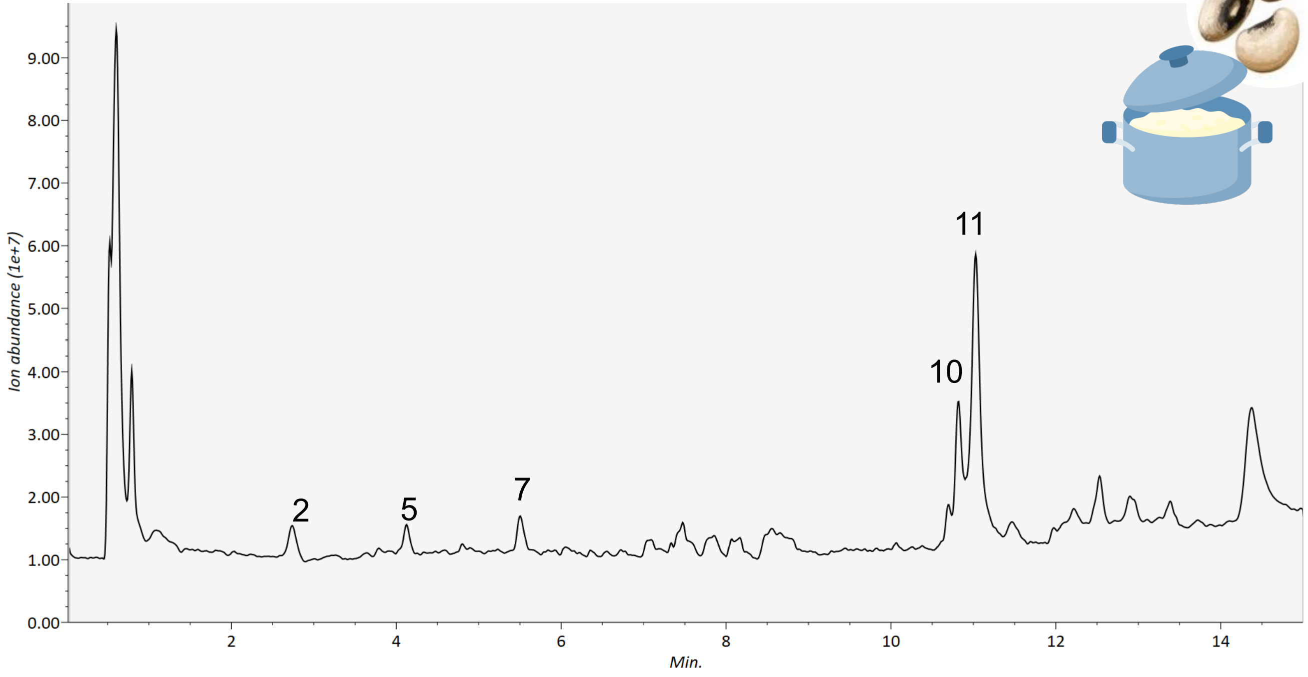
Most frequent compounds:

1) Flavonoids
2) Anthocyanins
3) Ellagic acid derivatives
4) Triterpenes

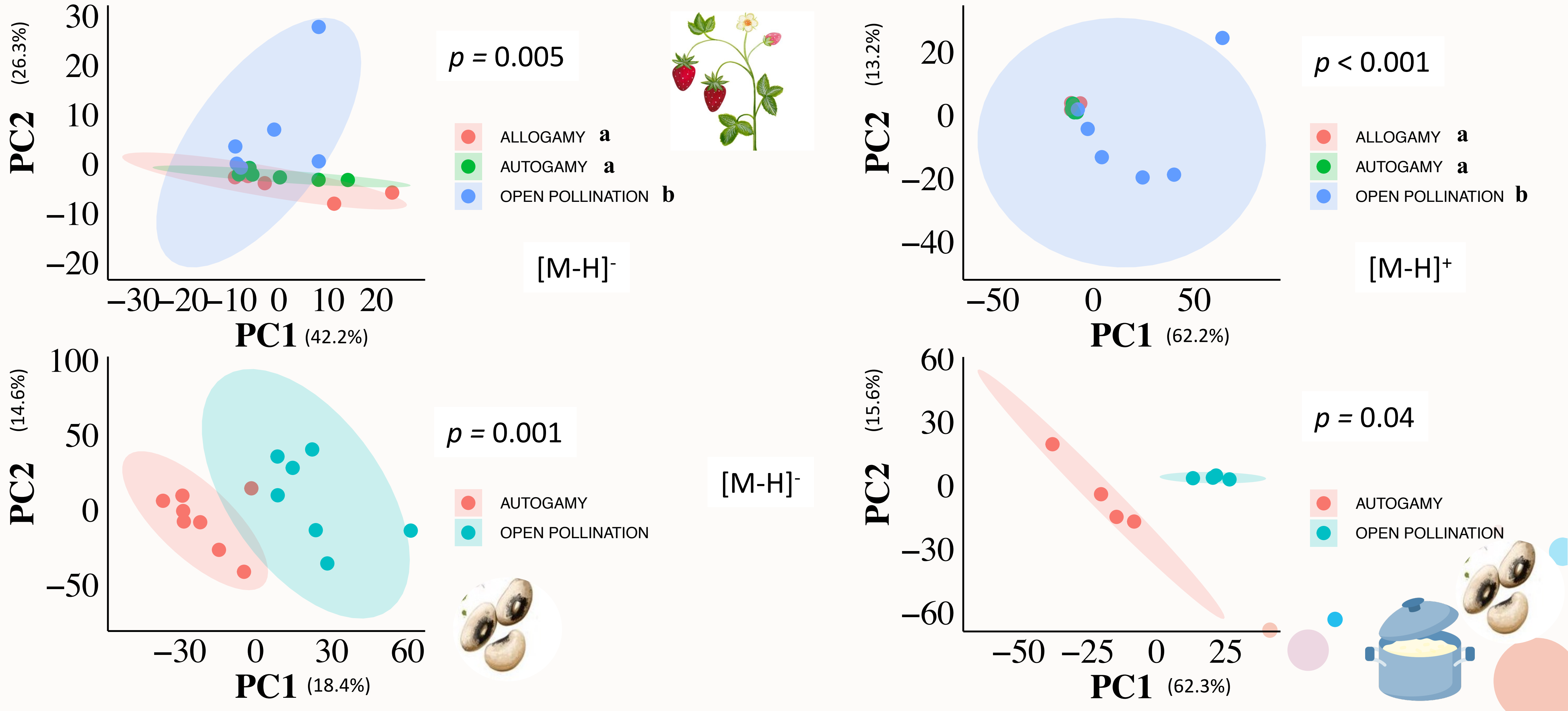
METABOLITES COMPOSITION

Peak	Ion current	Ion	Fragments	Tentative identification	Formula	References
1	[M-H]-	305	167, 175, 137, 125, 109	(-) Gallocatechin	$C_{15}H_{14}O_7$	Seyit Yuzuak, 2018
2	[M-H]-	451	289	Catechin 3-O-glucoside	$C_{21}H_{24}O_{11}$	Seyit Yuzuak, 2018
3	[M-H]-	577	451, 425, 407, 289	Procyanidin dimer	$C_{30}H_{26}O_{12}$	Ismael Ivan Rockenbach, 2012
4	[M-H]-	289	245, 221, 125, 109	(+) Catechin	$C_{15}H_{14}O_6$	Seyit Yuzuak, 2018
5	[M-H]-	865	695, 577, 543, 407, 451	Procyanidin trimer	$C_{45}H_{38}O_{18}$	Ismael Ivan Rockenbach, 2012
6	[M-H]-	387	225, 207	Medioresinol (Lignan)	$C_{21}H_{24}O_7$	Razgonova Mayya P. 2022
7	[M-H]-	625	301, 300, 463	Quercetin dihexoside	$C_{27}H_{30}O_{17}$	Leonnard O. Ojwang, 2012
8	[M-H]-	463	301, 300,271, 151	Quercetin hexoside	$C_{21}H_{20}O_{12}$	Junfeng Hao, 2021
9	[M-H]-	801	625, 301, 300	Quercetin-3-(6”-feruroyl)-glucoside	$C_{31}H_{28}O_{15}$	Leonnard O. Ojwang, 2012
10	[M-H]- [M-FA]-	941/987	-	Soyasapogenol A	$C_{30}H_{50}O_4$	Razgonova Mayya P. 2022
11	[M-H]-	957	-	Soyasapogenol B	$C_{30}H_{50}O_3$	Razgonova Mayya P. 2022



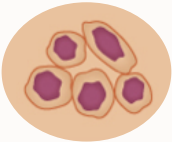


POLLINATION AND METABOLISM (2021)

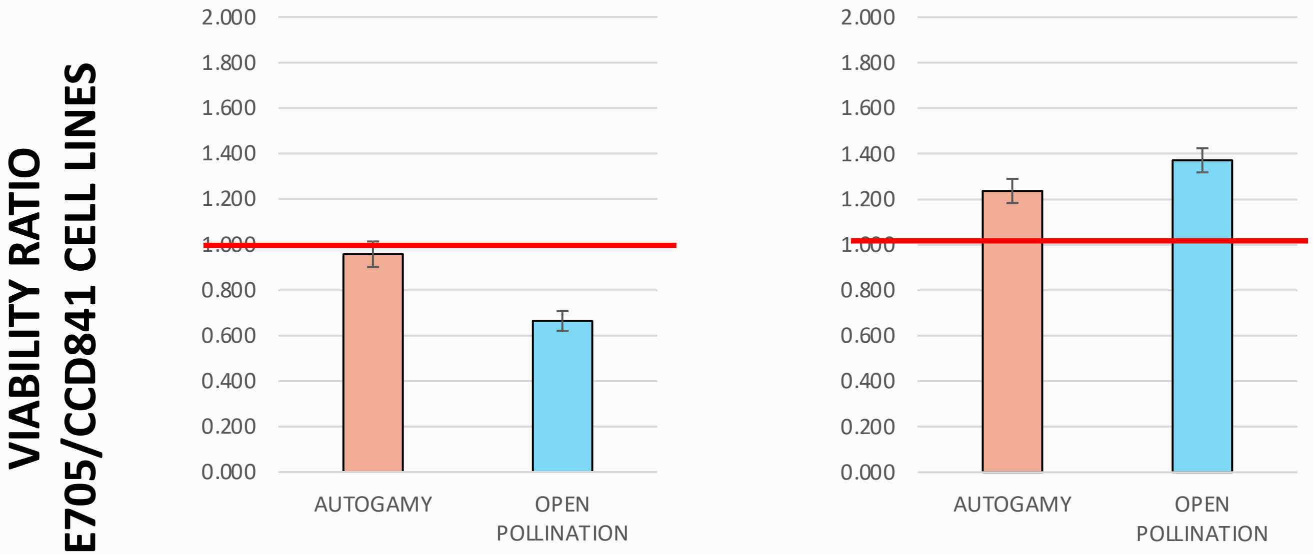


IMPACT ON HUMAN NUTRITION?

CCD841: HEALTHY COLON CELL LINE



E705: TUMOR COLON CELL LINE



$P < 0.001$

$P = 0.117$

OPEN POLLINATION

AUTOGAMY

NEXT STEPS…

Identification of the metabolites mainly influenced by pollination treatments both in *Vigna* and *Fragaria* sp.

Screening of the bioactive properties of strawberries from different pollination tratments on human *in vitro* models

Confirm or deny of the identified patterns by the 2022 growth season

THANK YOU FOR THE ATTENTION!

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