OP-251 [Beekeeping Technology and Quality]
Physico-chemical characteristics of honey powder: Impact of the botanical origin and the drying procedure

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Background/purpose and problem description: Honey is appreciated for its sweet flavor and their potential health benefits. The main drawback of honey is their high viscosity and stickiness. Honey powder is a good alternative. Due to the high amount of fructose and glucose it is necessary to add carriers in order to obtain the powder. However, large amount of carriers increases the costs and can alter the original flavor. The aim of this study was to characterize honey powder obtained by freeze (FZ) and vacuum drying (VC), using maltodextrin (MD) as carrier, from honeys of different botanical origin, using the most appropriate honey-maltodextrin ratio for each technique.

METHODOLOGY: 12 honeys [ling heater (LH), thyme (TH), lavender (LV), vetch (V) and multifloral (M)] collected by beekeepers from Spain were used. Honey was mixed with MD and powder was obtained by VC (60% honey) and FZ (75% honey). Moisture, water activity, color, hygroscopic rate, tapped density and solubility were determined.

RESULTS: Powder showed recoveries between 86 and 99%, obtaining FZ the highest recoveries, regardless of the botanical origin. Moisture was lower in VC than in FZ powders, showing LV, TH1 and M1 powders the lowest moisture. Aw, in general was higher in VC. The LV1 sample showed the lightest color intensity. In general VC samples exhibited higher a* values (red). Botanical origin influence in all color parameters, while drying procedure-honey concentration affect only to a*. FZ showed higher solubility (5-41 s) than VC (18-92 s), being the samples of LH the least soluble. The tapped density was higher in VC than in FZ and VC showed higher hygroscopic index (7.90-13.81%) than FZ (2.92-13.14%).

CONCLUSION: FZ provided the highest recovery, with a higher final honey concentration (75%), showing higher moisture and solubility and lower density and hygroscopicity than VC powders. Moisture, hygroscopicity, solubility and density depended on the drying procedure (using the most appropriate honey-MD ratio). Moisture, color, solubility and density depended on honey's botanical origin. Practical implications for beekeepers: Honey powder is a promising substitute for honey in food, cosmetic and pharmaceutic industries, being labeling as “Real Food”, helping to promote the beekeeping.

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PHYSICO-CHEMICAL CHARACTERISTICS OF HONEY POWDER: IMPACT OF THE BOTANICAL ORIGIN AND THE DRYING PROCEDURE

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BACKGROUND

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Fructose & Glucose (70%)

Water (18%)

Amino acids proteins & enzymes

Organic acids

Minerals & vitamins

Phenolic comp.

Antioxidant

Antimicrobial

Healing

Anti-inflamatory

sugar

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BACKGROUND

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SUGARS

Viscosity
Stickiness
Glucose crys

Food & Pharmaceutical industries

Ease of handling, stored, transported and mixed

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BACKGROUND

T_g -40 y -51ºC

CARRIERS:
- Arabic gum
- Maltodextrin
- Whey protein isolate
- Sodium caseinate
- Starch

Spray drying

Vacuum drying

Freeze drying

Cost

Alter original flavor

AIM

TO CHARACTERIZE HONEY POWDER OBTAINED BY FREEZE AND VACUUM DRYING, USING MALTODEXTRIN AS CARRIER, FROM HONEYS OF DIFFERENT BOTANICAL ORIGIN, USING THE MOST APPROPRIATE HONEY-MALTODEXTRIN RATIO FOR EACH TECHNIQUE

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METHODOLOGY

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Honey	Family	Scientific name	Common name
LH1	Ericaceae	Calluna vulgaris (L.) Hull	Ling heather
LH2	Ericaceae	Calluna vulgaris (L.) Hull	Ling heather
LH3	Ericaceae	Calluna vulgaris (L.) Hull	Ling heather
TH1	Labiatae	Thymus sp.	Thyme
TH2	Labiatae	Thymus sp.	Thyme
LV1	Labiatae	Lavandula hybrida Reverchon	Lavender
LV2	Labiatae	Lavandula latifolia Medik	Lavender
LV3	Labiatae	Lavandula stoechas Lam	Lavender
V1	Leguminosae	Vicia sp.	Vetch
M1	Multifloral	-	Multifloral
M2	Multifloral	-	Multifloral
M3	Multifloral	-	Multifloral

MALTODEXTRIN (MD)

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METHODOLOGY

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VACUUM DRYING

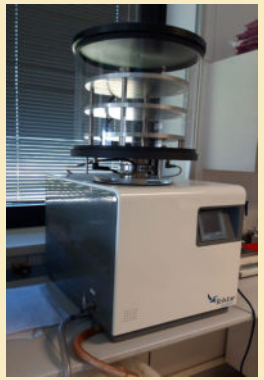
VC

- Solid concentration of 43-48% (w/w)
- Silicon baking cup 3-4 mm thickness
- Lab scale vacuum oven at 60 ˚C, pressure at 100 mbar (75 mmHg) for 48 h
- Grounded with a mortar

60% Honey

FREEZE DRYING

FZ



- Solid concentration of 43-48% (w/w)
- Silicon baking cup 3-4 mm thickness
- Frozen at -30 ˚C /5 h
- Frozen at -80 ˚C /24 h
- Freeze drying 3 days a 0,057 mbar
- Grounded with a mortar

75% Honey

Moisture
Water activity
Color
Hygroscopic rate
Tapped density
Solubility

METHODOLOGY

Recovery

$$\%\ \text{powder recovery} = \frac{\text{Total solids in } powder}{Total\ solids\ content\ in\ feed} \text{ x } 100$$

Moisture

Gravimetrically by drying 1 g at 105 °C/4h

Water activity

Color

L*, a*, b*

Hygroscopic index

1 g in desiccators at room temperature and equilibrated over a saturated solution of NaCl (75% relative humidity) for one week

Tapped density

2 g in a graduated cylinder, tapping 25 times and recording the volumen

Solubility

1 g to 25 ml of distilled water in a 100 ml glass at room temperatura stirrer at 890 rpm, recording the time required to dissolve completely

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RESULTS

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RECOVERIES

- Powder showed recoveries between 86 and 99%
- FZ obtained the highest recoveries, regardless the botanical origin
- LH showed the lowest recovery for FZ samples

a-b: different letters show significant differences ($p < 0.05$) among the different botanical origins.
A-B: different letters show significant differences ($p < 0.05$) between drying procedures.

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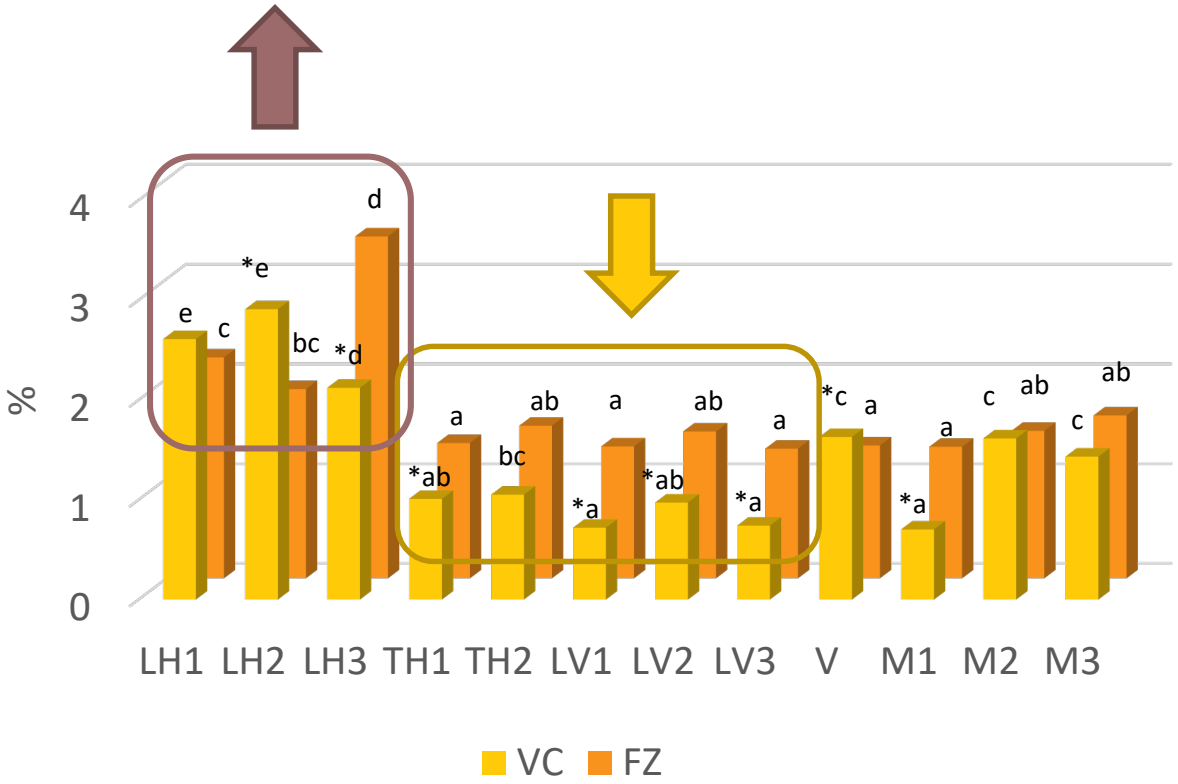
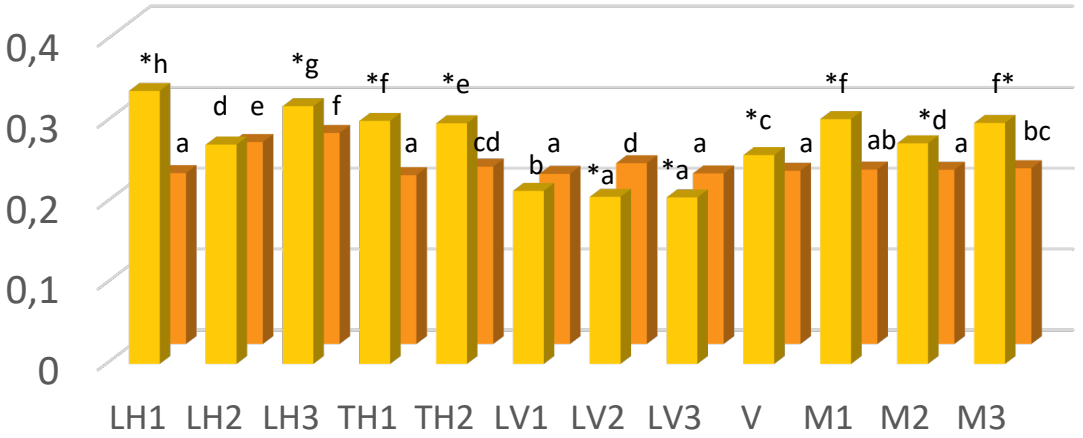
RESULTS

MOISTURE & Aw

- Moisture was lower in VC than in FZ powders
- LV, TH1 & M1 powders showed the lowest moisture
- LH showed the highest moisture
- Aw in general was higher in VC





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RESULTS

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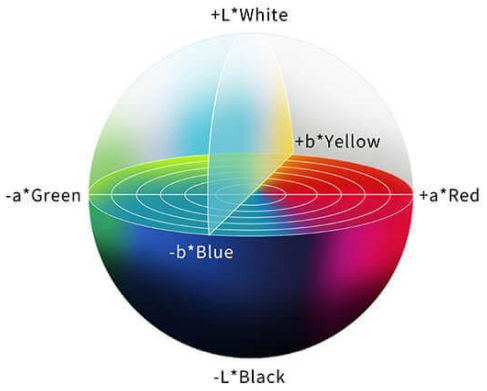
COLOR



- The LV & V sample showed the lightest color intensity
- In general VC samples exhibited higher a* values (red)
- Botanical origin influenced in all color parameters
- Drying procedure-honey concentration affected only to a*

L*

	LH1	LH2	LH3	TH1	TH2	LV1	LV2	LV3	V	M1	M2	M3
VC	$_{A}58{,}72\pm0{,}16^{a}$	$_{A}63{,}43\pm0{,}03^{b}$	$_{A}77{,}00\pm0{,}02^{e}$	$_{A}77{,}75\pm0{,}02^{f}$	$_{A}78{,}94\pm0{,}03^{g}$	$_{B}89{,}84\pm0{,}01^{k}$	$_{B}83{,}20\pm0{,}01^{h}$	$_{B}88{,}77\pm0{,}01^{j}$	$_{B}88{,}69\pm0{,}01^{j}$	$_{A}74{,}61\pm0{,}18^{c}$	$_{A}84{,}27\pm0{,}02^{i}$	$_{A}75{,}05\pm0{,}01^{d}$
FZ	$_{B}71{,}00\pm0{,}03^{b}$	$_{B}69{,}46\pm0{,}17^{a}$	$_{B}83{,}05\pm0{,}03^{ef}$	$_{B}81{,}98\pm0{,}07^{e}$	$_{A}79{,}27\pm0{,}01^{d}$	$_{A}87{,}71\pm0{,}08^{h}$	$_{A}75{,}88\pm0{,}03^{c}$	$_{A}84{,}86\pm0{,}01^{g}$	$_{A}86{,}57\pm0{,}03^{h}$	$_{B}84{,}48\pm0{,}05^{fg}$	$_{A}84{,}55\pm1{,}76^{fg}$	$_{B}79{,}16\pm0{,}00^{d}$

a*

	LH1	LH2	LH3	TH1	TH2	LV1	LV2	LV3	V	M1	M2	M3
VC	$_{B}8{,}46\pm0{,}10^{j}$	$_{B}7{,}84\pm0{,}01^{i}$	$_{B}2{,}73\pm0{,}00^{h}$	$_{B}2{,}22\pm0{,}01^{f}$	$_{B}2{,}30\pm0{,}01^{g}$	$_{B}-1{,}28\pm0{,}01^{a}$	$_{A}1{,}45\pm0{,}01^{d}$	$_{B}-0{,}78\pm0{,}00^{b}$	$_{B}-1{,}22\pm0{,}01^{a}$	$_{B}1{,}71\pm0{,}01^{e}$	$_{B}1{,}13\pm0{,}01^{c}$	$_{B}2{,}69\pm0{,}01^{h}$
FZ	$_{A}5{,}74\pm0{,}02^{j}$	$_{A}6{,}04\pm0{,}09^{k}$	$_{A}1{,}15\pm0{,}02^{h}$	$_{A}-0{,}87\pm0{,}01^{d}$	$_{A}0{,}68\pm0{,}03^{g}$	$_{A}-1{,}67\pm0{,}00^{a}$	$_{B}2{,}85\pm0{,}02^{i}$	$_{A}-1{,}32\pm0{,}01^{b}$	$_{A}-1{,}75\pm0{,}00^{a}$	$_{A}-1{,}05\pm0{,}02^{c}$	$_{A}-0{,}57\pm0{,}02^{e}$	$_{A}0{,}46\pm0{,}01^{f}$

b*

	LH1	LH2	LH3	TH1	TH2	LV1	LV2	LV3	V	M1	M2	M3
VC	$_{B}31{,}00\pm0{,}26^{k}$	$_{B}32{,}60\pm0{,}03^{l}$	$_{B}27{,}37\pm0{,}02^{j}$	$_{B}26{,}71\pm0{,}01^{i}$	$_{B}24{,}970{,}03^{f}$	$_{A}11{,}62\pm0{,}01^{a}$	$_{A}20{,}01\pm0{,}01^{e}$	$_{A}13{,}21\pm0{,}01^{b}$	$_{B}13{,}69\pm0{,}02^{c}$	$_{B}25{,}27\pm0{,}01^{h}$	$_{B}19{,}43\pm0{,}02^{d}$	$_{B}23{,}90\pm0{,}01^{g}$
FZ	$_{A}28{,}40\pm0{,}03^{i}$	$_{A}29{,}05\pm0{,}19^{k}$	$_{A}20{,}92\pm0{,}31^{g}$	$_{A}18{,}26\pm0{,}31^{e}$	$_{A}22{,}30\pm0{,}06^{h}$	$_{B}12{,}20\pm0{,}01^{b}$	$_{B}28{,}73\pm0{,}06^{j}$	$_{B}14{,}10\pm0{,}05^{c}$	$_{A}10{,}82\pm0{,}04^{a}$	$_{A}17{,}06\pm0{,}04^{d}$	$_{A}17{,}24\pm0{,}02^{d}$	$_{A}19{,}24\pm0{,}01^{f}$

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RESULTS

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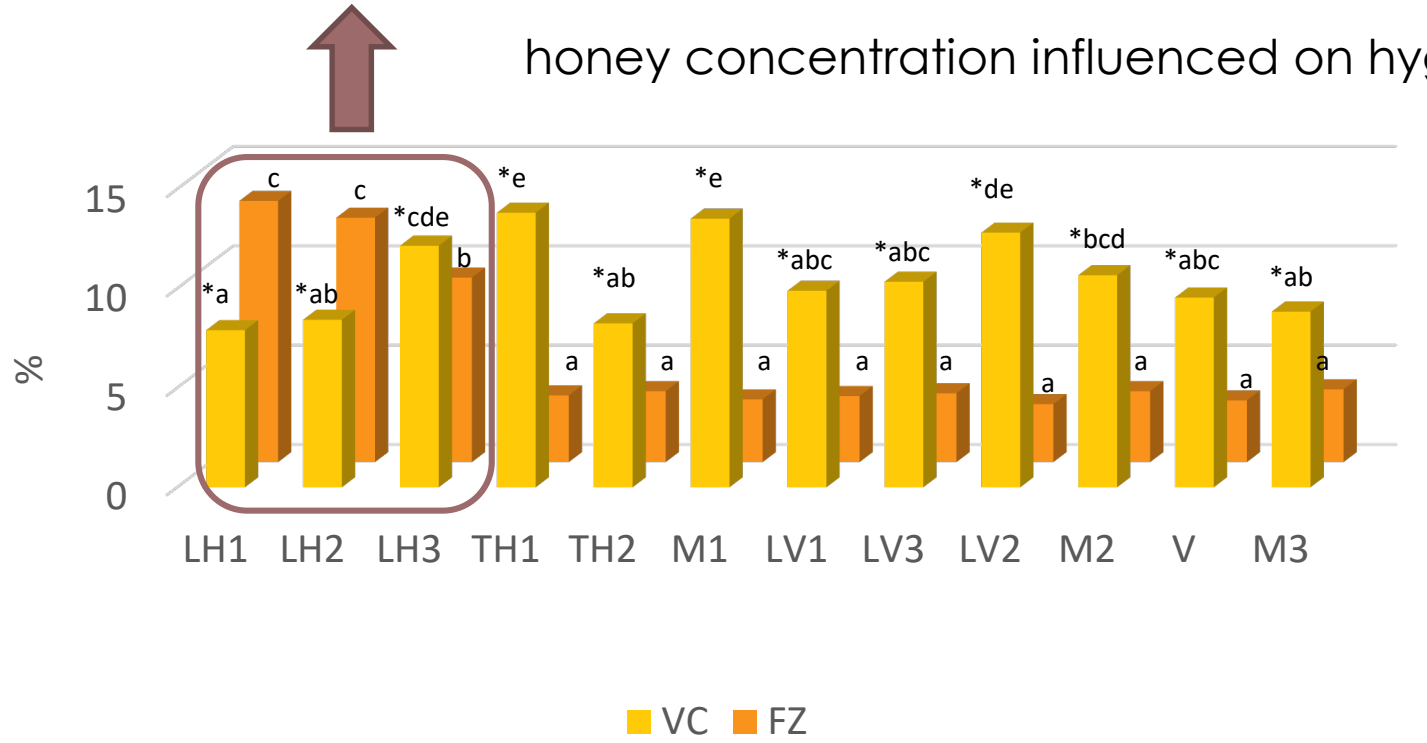
HYGROSCOPIC INDEX

- VC (7,9-13,8%) showed higher hygroscopic index than FZ (2,92-13,14%)
- LH showed the highest hygroscopic index in FZ samples
- Botanical origin and its interaction with drying procedure-honey concentration influenced on hygroscopic index



a-b: different letters show significant differences ($p < 0.05$) among the different botanical origins.
* show significant differences ($p < 0.05$) between drying procedures.

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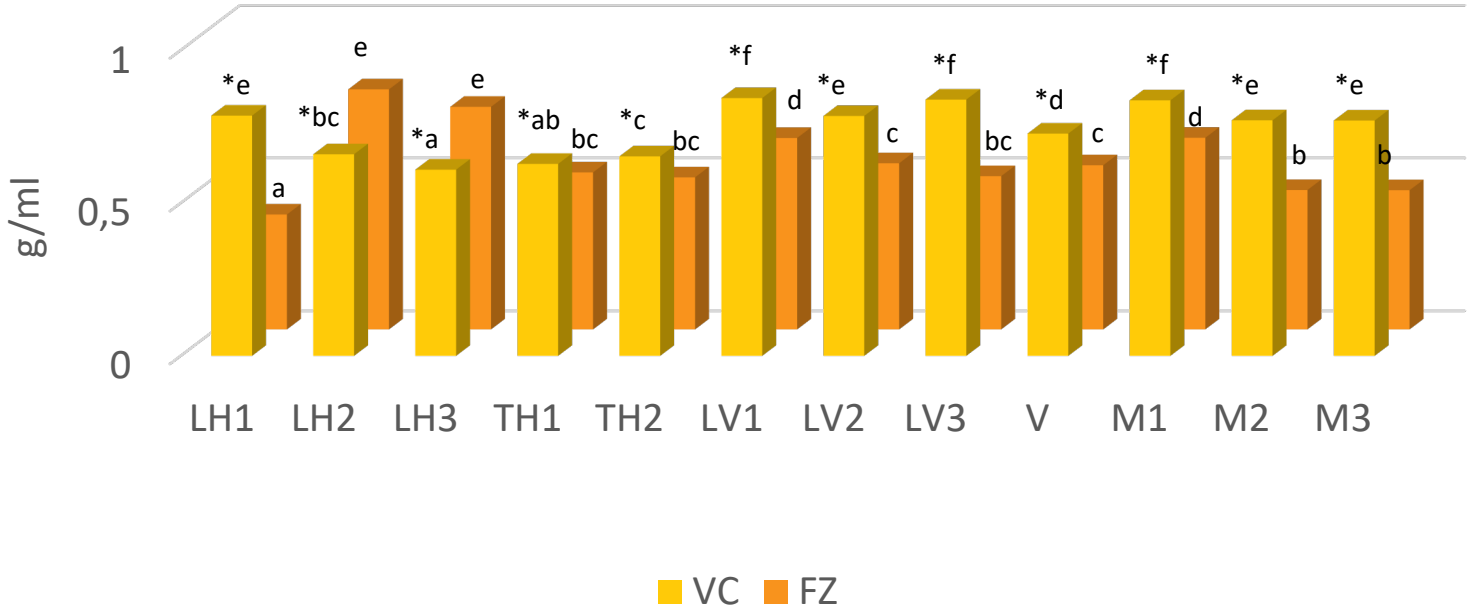
RESULTS

TAPPED DENSITY

- Tapped density was higher in VC than in FZ
- Tapped density was influenced by drying procedure
- A negative correlation with moisture was observed
- FZ needed larger spaces for storage and packaging than other procedures. However, it is less susceptible to cohesion and agglomeration



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* show significant differences ($p < 0.05$) between drying procedures.

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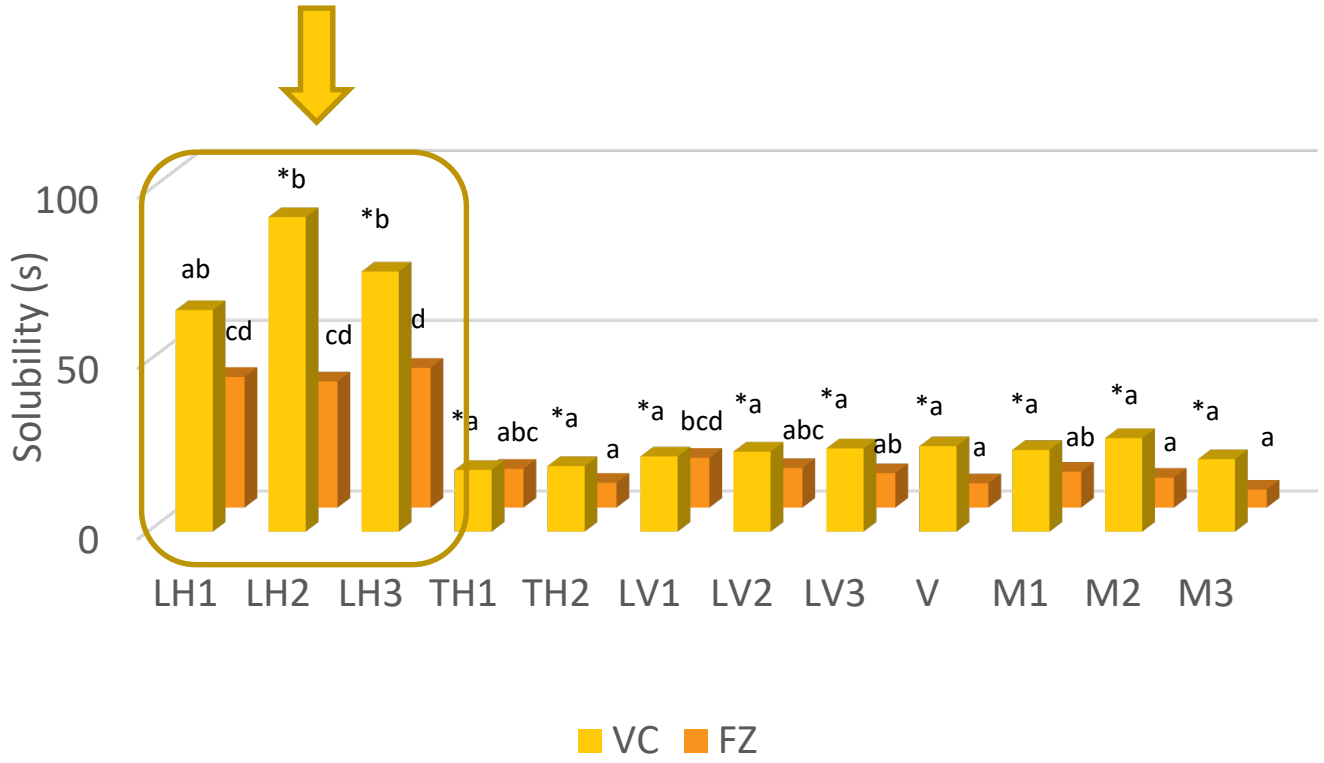
RESULTS

SOLUBILITY

- FZ showed higher solubility (5-41 s) than VC (18-92 s)
- LH samples are the least soluble
- Strong positive correlation with tapped density



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RESULTS

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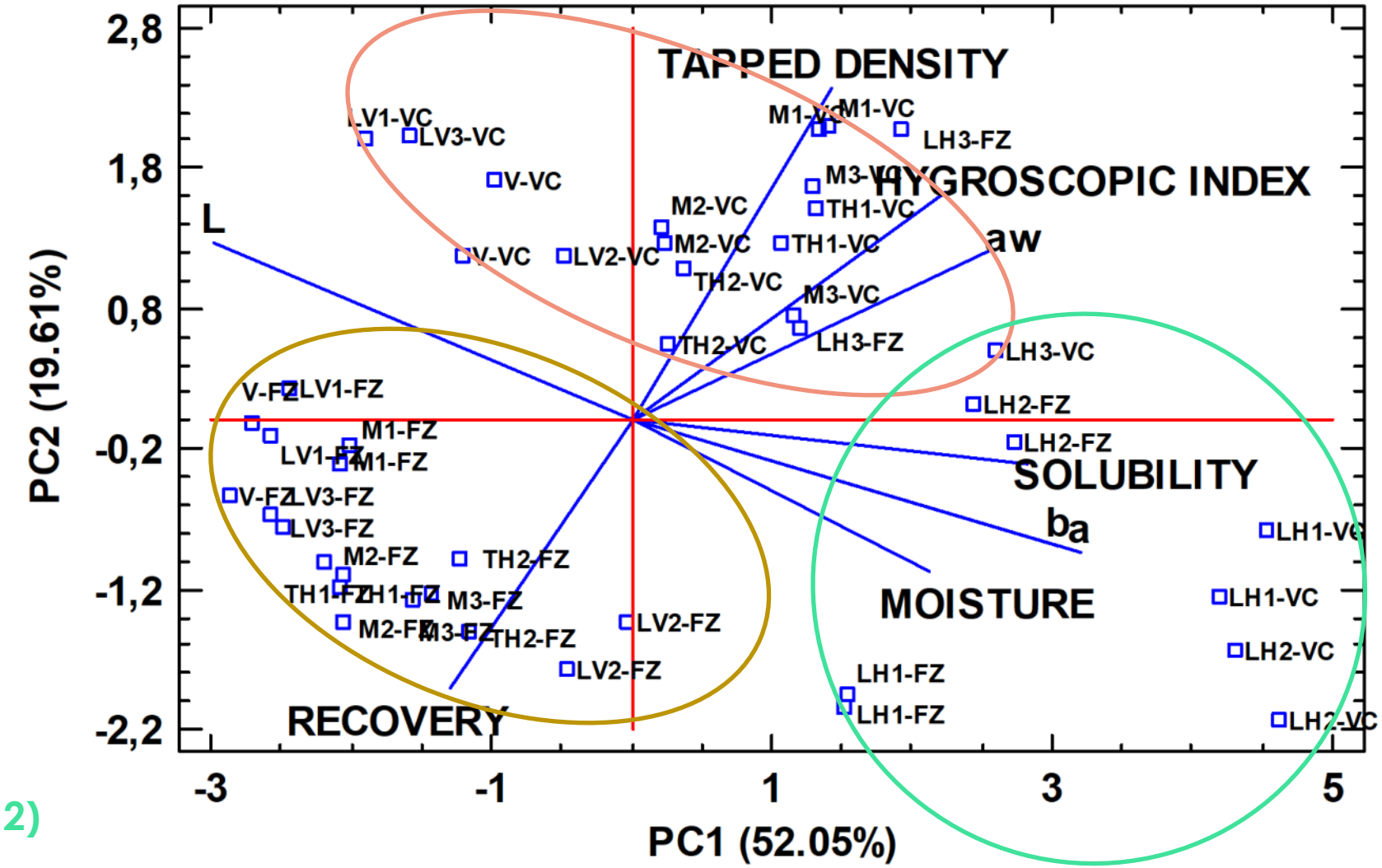

GROUP 1: FZ SAMPLES

GROUP 2: VC SAMPLES

GROUP 3: LH SAMPLES (1 & 2)

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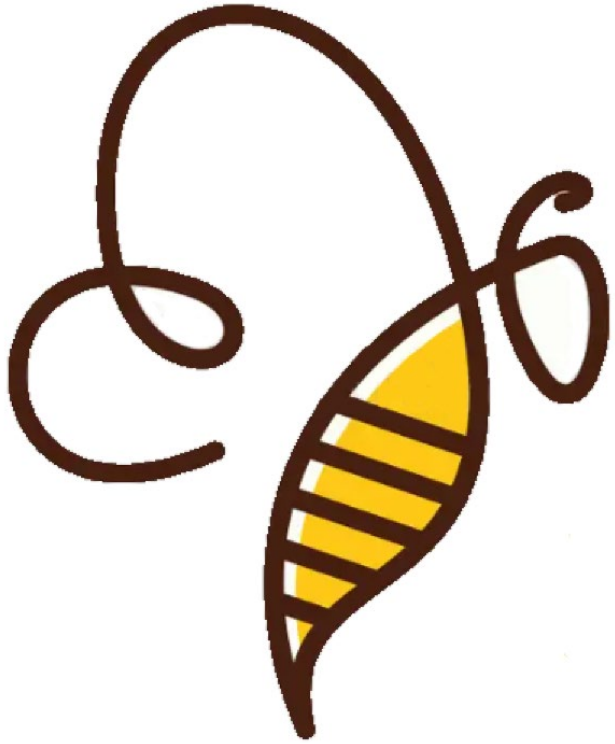
CONCLUSIONS



- FZ PROVIDED THE HIGHEST RECOVERY, WITH A HIGHER FINAL HONEY CONCENTRATION
- FZ SHOWED HIGHER MOISTURE AND SOLUBILITY AND LOWER DENSITY AND HYGROSCOPICITY
- MOISTURE, HYGROSCOPICITY, SOLUBILITY AND DENSITY DEPENDED ON THE DRYING PROCEDURE (HONEY-MD RATIO)
- MOISTURE, COLOR, SOLUBILITY AND DENSITY DEPENDED ON HONEY'S BOTANICAL ORIGIN

PRACTICAL IMPLICATIONS FOR BEEKEEPERS:

HONEY POWDER IS A PROMISING SUBSTITUTE FOR HONEY IN FOOD, COSMETIC AND PHARMACEUTIC INDUSTRIES, BEING LABELLING AS "REAL FOOD", HELPING TO PROMOTE THE BEEKIEEPING

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Attributes of ling-Heather honey powder obtained by different methods with several carriers

Osés, S. M., Cantero, L., Crespo, M., Puertas, G., González-Ceballos, L., Vallejos, S., Fernández-Muiño, M. A & Sancho, M. T. (2021). LWT-Food Science and Technology, 150, 112063. https://doi.org/10.1016/j.lwt.2021.112063

Impact of the drying procedure and botanical origin on the physico-chemical and potentially bioactive properties of honey powders

Cantero, L., González-Ceballos, L., Vallejo, S., Puertas, G., Fernández-Muiño, M. A., Sancho, M. T & Osés, S. M. (2023). Foods, 12, 3990. https://doi.org/10.3390/FOODS12213990

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