New alternatives to milk from pulses: digestibility and bioactivity

Duarte C.M. [1], Mota J. [1], Assunção R. [2], Martins C[2]., Raymundo A. [1], Nunes C.[1], Alvito P. [2], Boavida-Ferreira R. [1], **Sousa I. [1]**

[1]LEAF – Linking Landscape, Environment, Agriculture and Food, Instituto Superior de Agronomia, Universidade de Lisboa. Tapada da Ajuda, 1349-017 Lisbon, Portugal

[2] Food and Nutrition Department, National Institute of Health Doutor Ricardo Jorge (INSA), Lisboa, Portugal

FCT-2020

LEAF
LINKING LANDSCAPE, ENVIRONMENT, AGRICULTURE AND FOOD

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Plant Based Alternatives to milk

Samples	Protein (% w/v)	Hydrocolloids	Sugars
Skimmed milk	3.5	No	No
Oat beverage	0.2	Yes	No
Almond beverage	0.5	Yes	No
Hazelnut beverage	0.4	Yes	Yes
Coconut beverage	0.1	Yes	No
Quinoa beverage	0.8	Yes	No
Nut beverage	0.2	Yes	No
Dry nuts beverage	0.6	Yes	Yes
Rice beverage	0.1	No	No

- Protein content:

0.1 – 0.8% vs 3.5 – 4.0% (milk)

- Gums added to replace the protein effect on viscosity and mouthfeel
- Sugars, for mouthfeel and consumer acceptance
- Sunflower oil for smoothness

😕 Bad example of nutritional replacement!

European Pulse-based beverages

- Lupin
- Chickpea
- Yellow Pea
- Green Pea

Protein content: 20-40%

TARGETS

Clean Label

Zero Waste

Dry seeds – SOAKING

- Raw seeds milling
- Seeds germination
- Seeds roasting
- **Cooking**

Milling

BEVERAGES (min. 10% seeds)

1. With whole seed (incl. peel)
2. No additives
3. No hydrocolloids

Pulse-based beverages

FIRST PRODUCTION ISSUES:

- Gel formation in beverage (pea)
- Sandy mouthfeel (strong milling)
- “Beany flavor” (cooking after milling)

CHICKPEA

After agitation

LUPIN

After agitation

PEA

After agitation

PROCESS OPTIMIZATION

SELECTED PULSES:

- ✓ Lupin
- ✓ Chickpea

"BEANY FLAVOUR" MITIGATION

PARTICLE'S REDUCTION Crucial step

SEEDS SOAKING

SEEDS COOKING

MILLING

BOTTLE FILLING

BEVERAGE PASTEURIZATION

PEELs REMOVAL ??

Mixer+ Ultraturrax – 14% residue

Colloidal Mill – 2% residue

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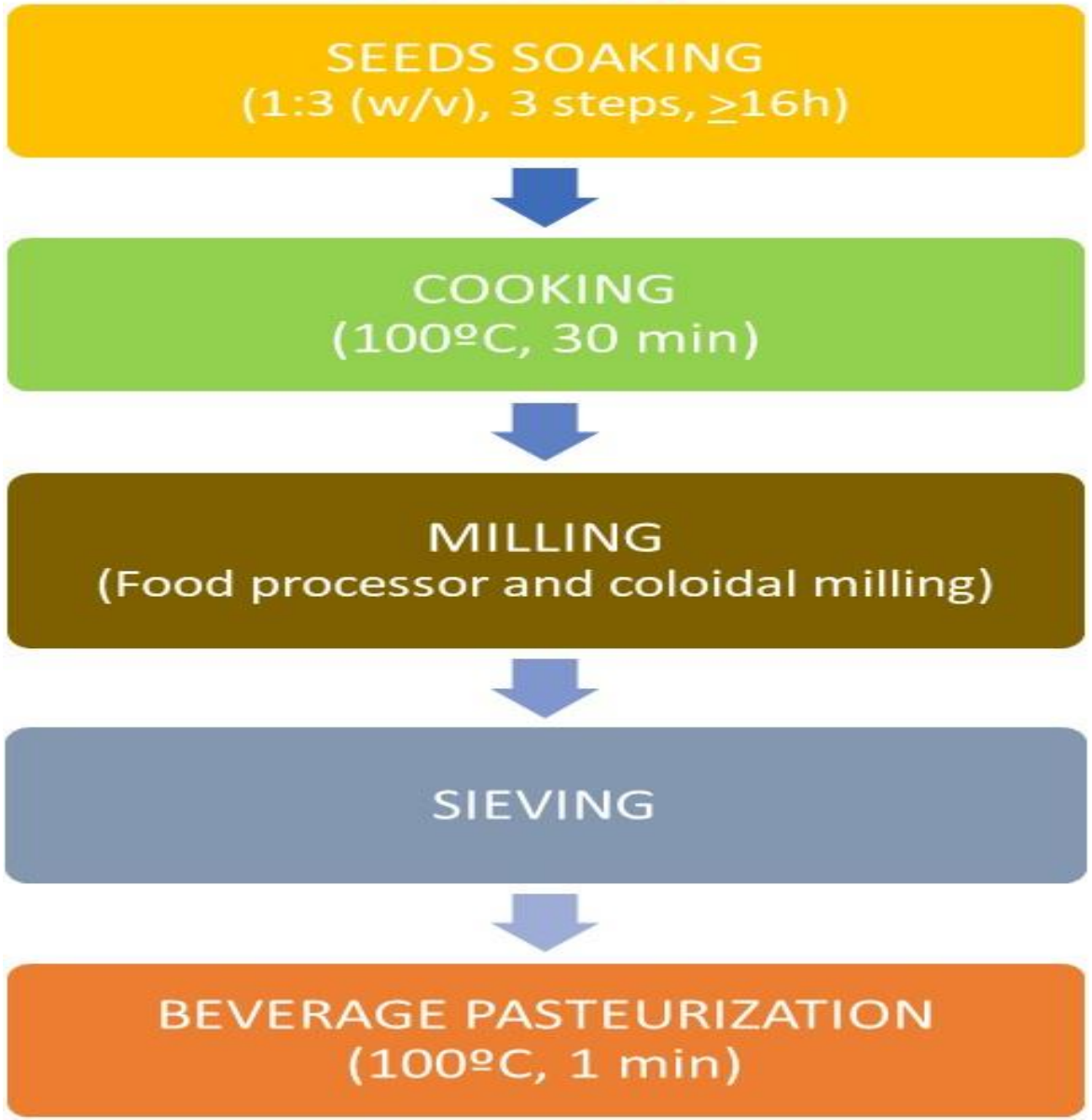
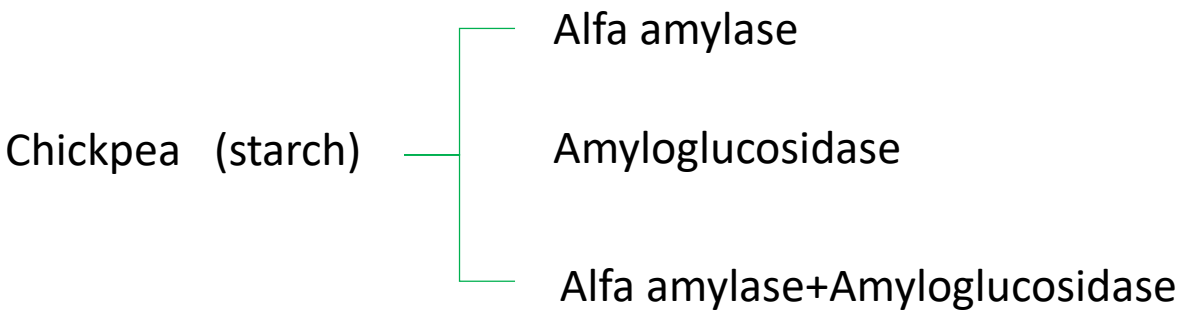
Procedure



BEVERAGES TO TEST

Lupin Chickpea Lupin + Chickpea



Digestibility tests - All six pulse beverages were submitted to static in vitro digestion method according to Brodkorb and coworkers (2019);

Physicochemical analysis of pulse beverages and its respective digesta:

- **Total Protein** was determined by Lowry-Peterson method (Peterson, 1983);
- **Total Starch** analysis was performed according to Megazyme Total Starch Assay Procedure (K-TSTA) based on AOAC official method 996.11 (1996);
- **D-glucose** content was obtained by HPLC (Santos et al., 2019);
- **Carbohydrates** content was carried out according to Dubois et al. (1951);
- **Minerals** content were carried out by inductively coupled plasma optical emission spectrometry (ICP-OES);
- **Phytic acid** content was performed according to Megazyme Phytic Acid assay kit (K-PHYT);
- **The glycemic index** of pulse-based beverages was determined by starch hydrolysis *in vitro* procedure according to Goñi et al. (1997).

BIOACTIVITIES

Anti-oxidant activity:

- Total phenolic compounds were determined using the method reported by Otkay et al. (2003) with some modifications;

- The scavenging effect of pulse beverage extracts was determined using the **DPPH** methodology (Sánchez-Moreno et al, 1999);

- The reducing power of the pulse beverage extracts was determined using the ferric ion reducing antioxidant power (**FRAP**) assay adapted from Rufino et al., 2006.

No anti-oxidante activity was found in pulse beverages.

Anti-inflammatory and anti-cancer bioactivities – next experimental trials (Nov 2020)

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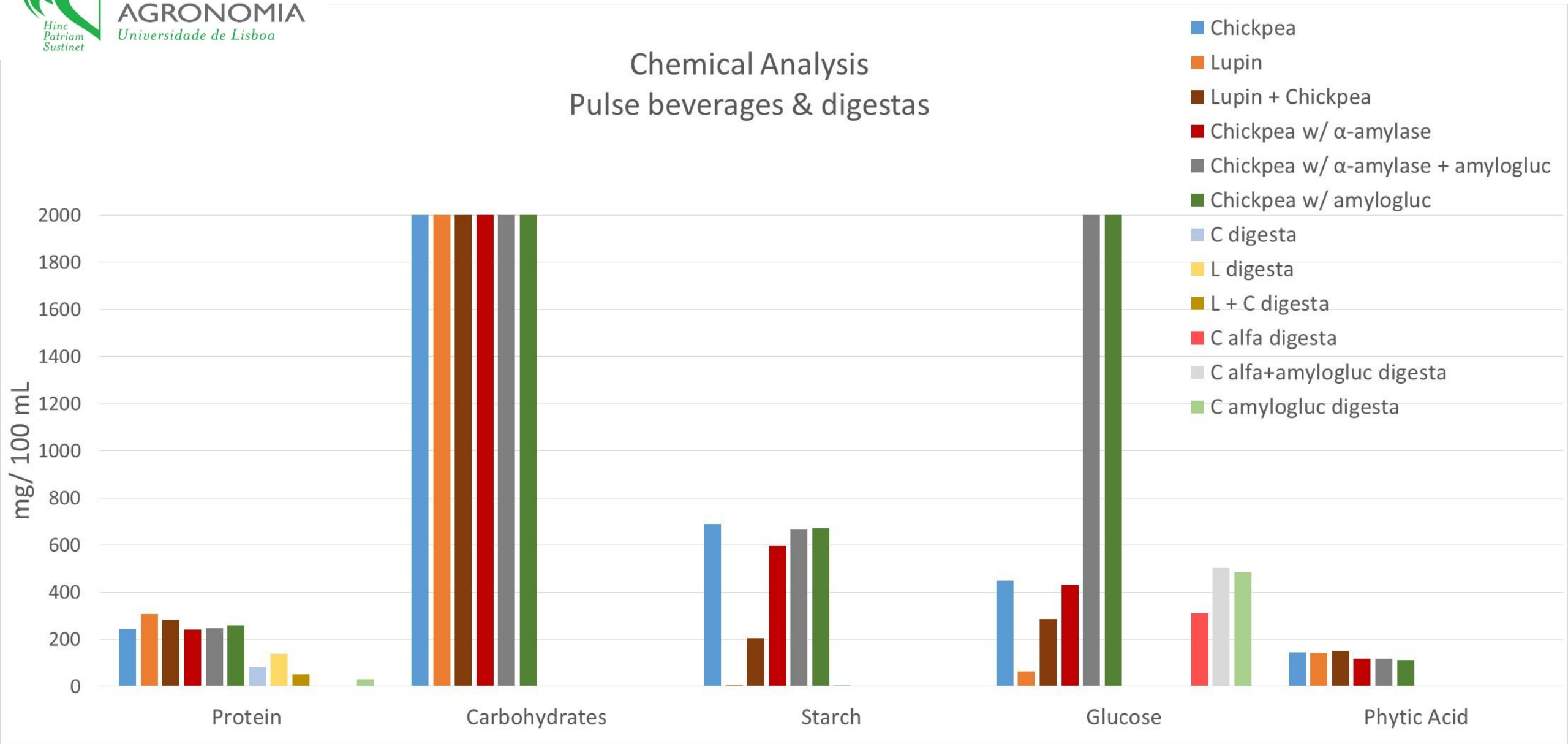

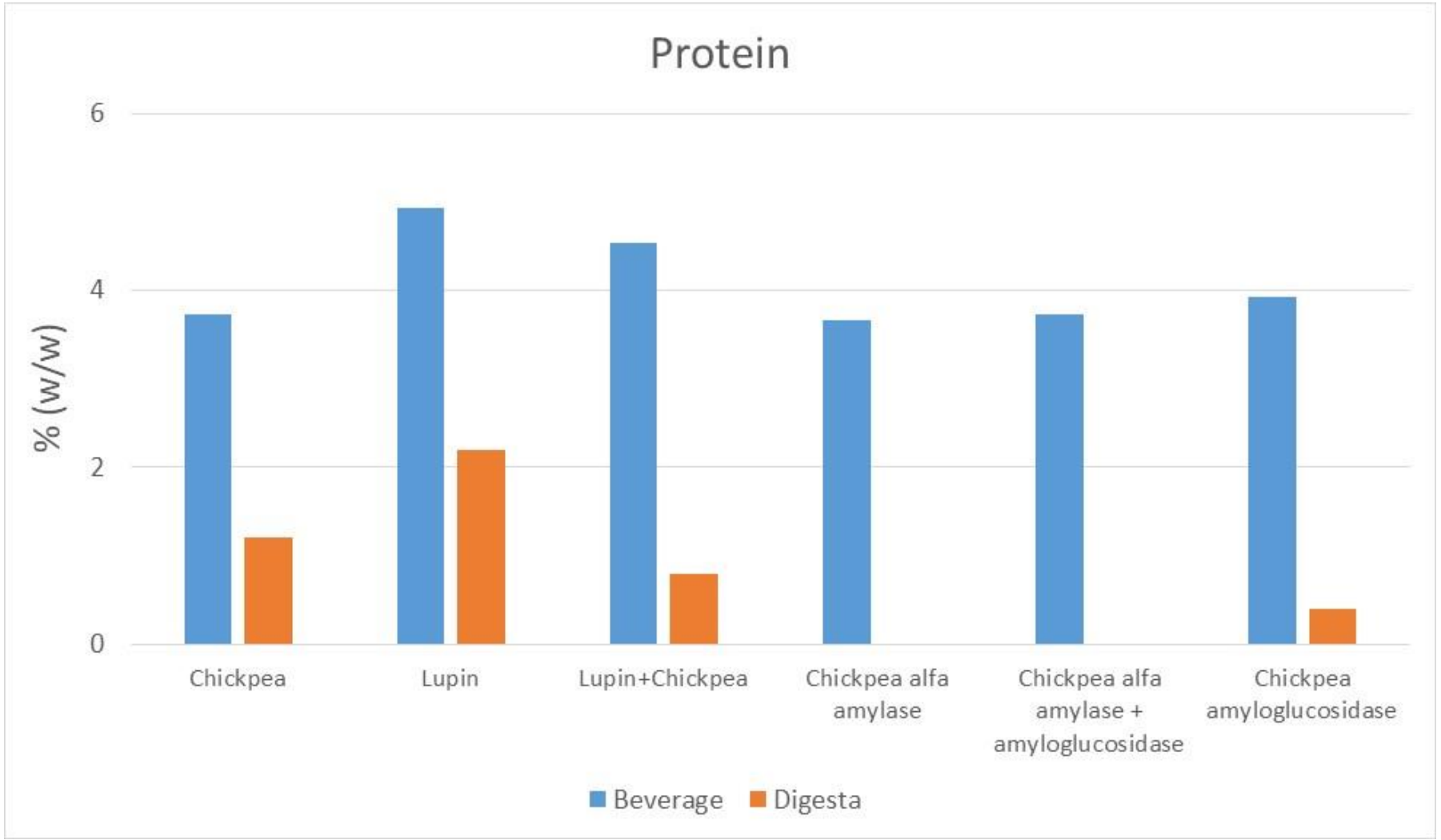

Glycemic Index	%
Lupin	**42.6**
Chickpea	56.9
Lupin+Chickpea	48.9
Chickpea+Amylase	64.8
Chickpea+ Amyloglucosidase	78.9
Chickpea+Amylase +Amylog	**85.3**

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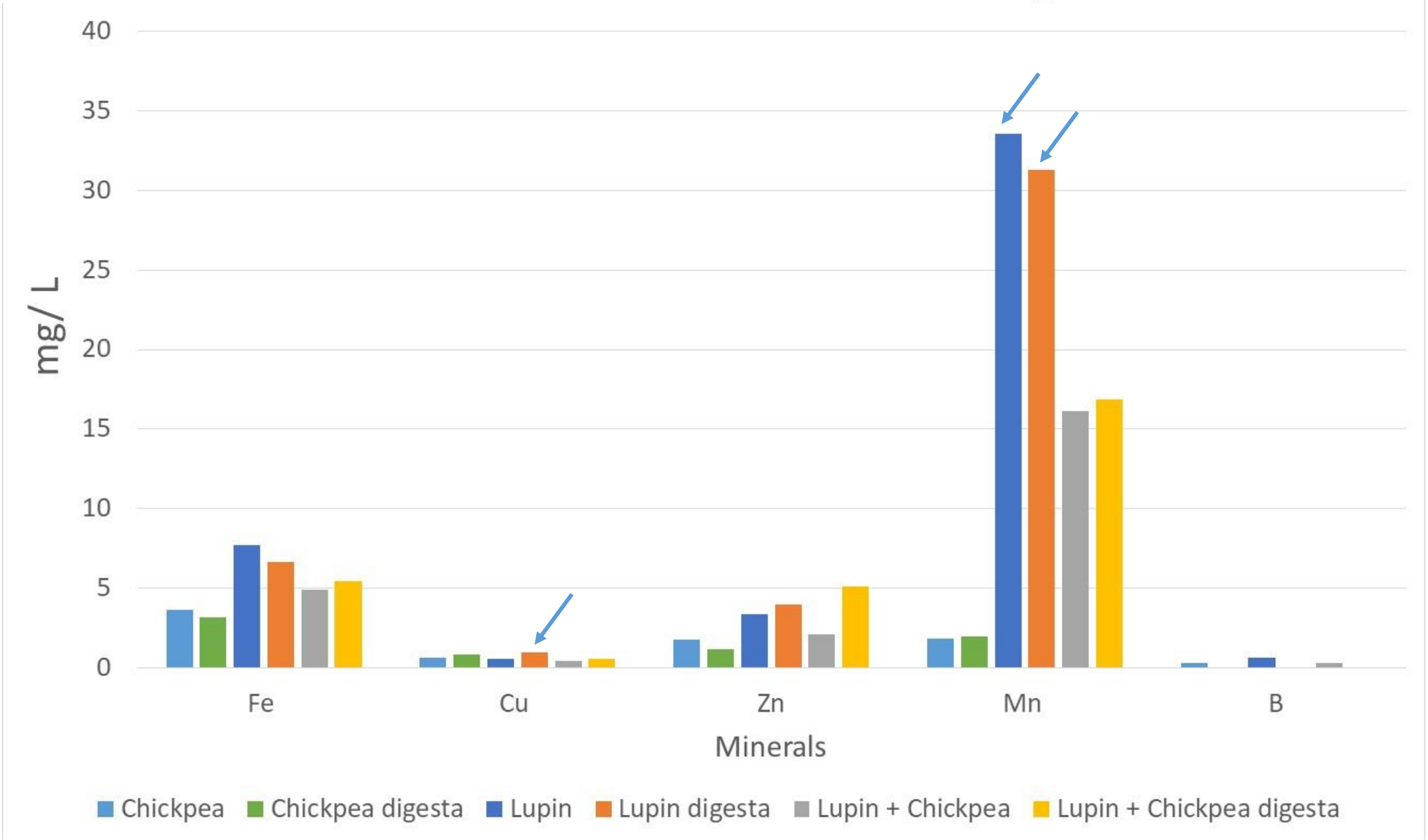
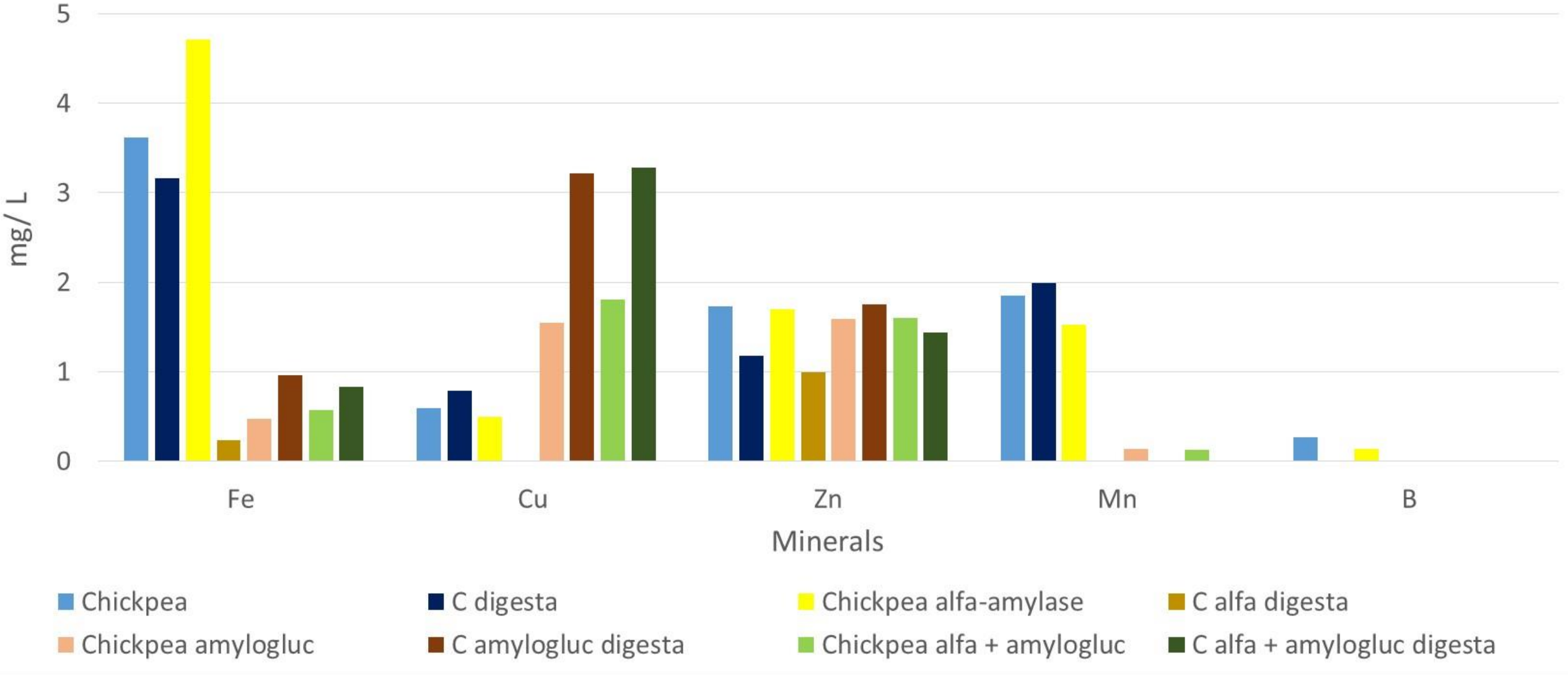
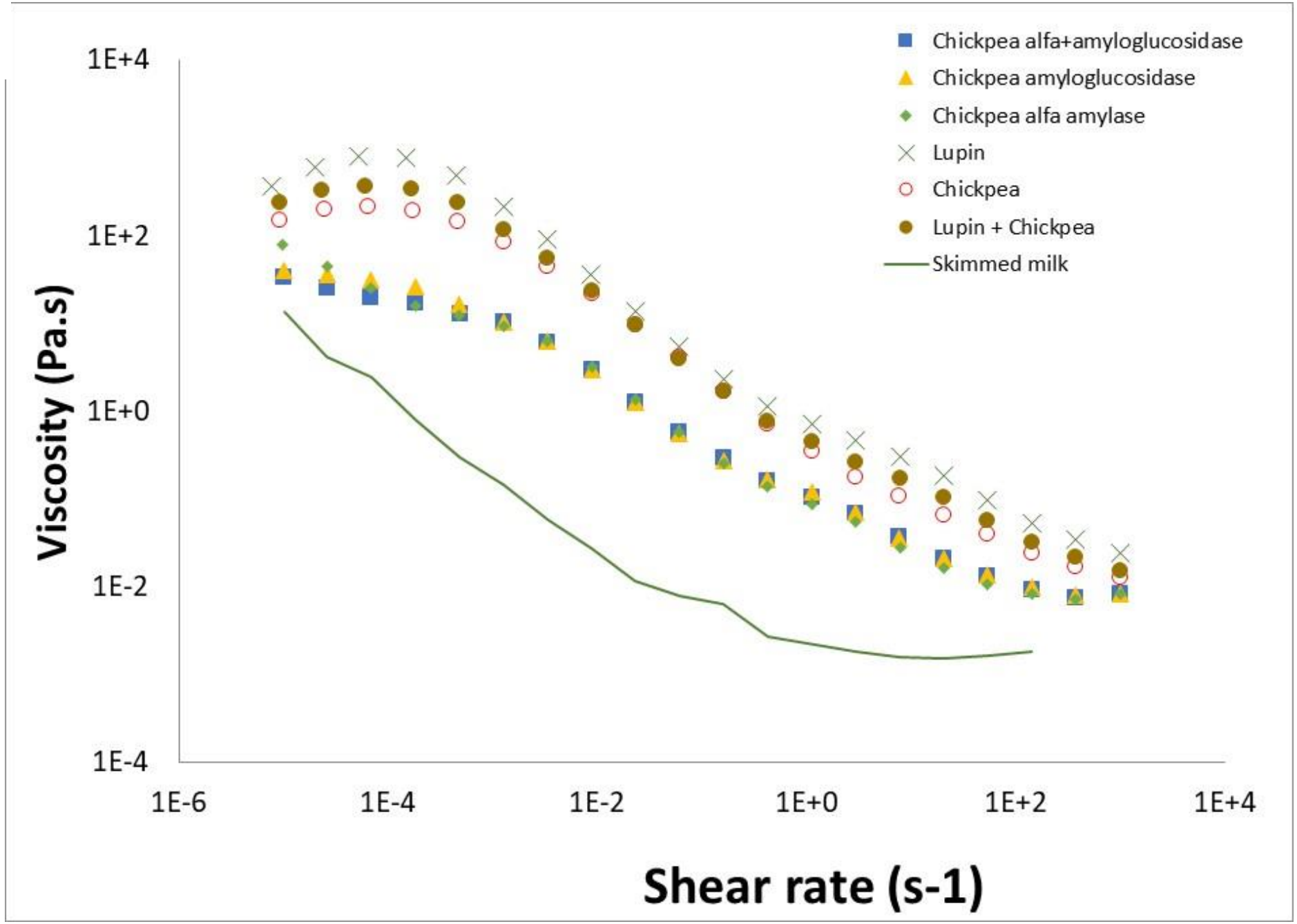
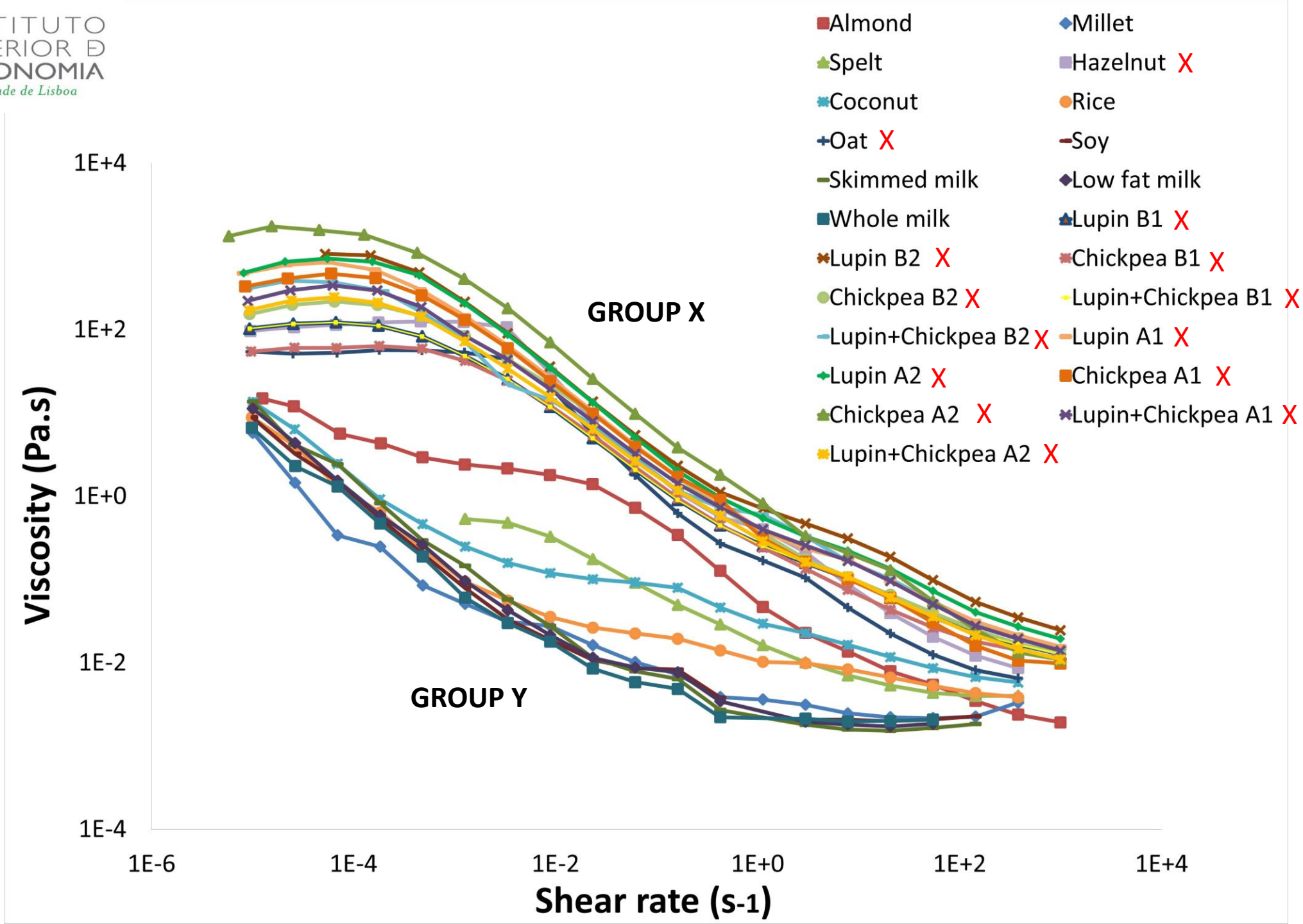
Chickpea, Lupin, and mixture (50/50) beverages
Mineral content - before and after in vitro digestion

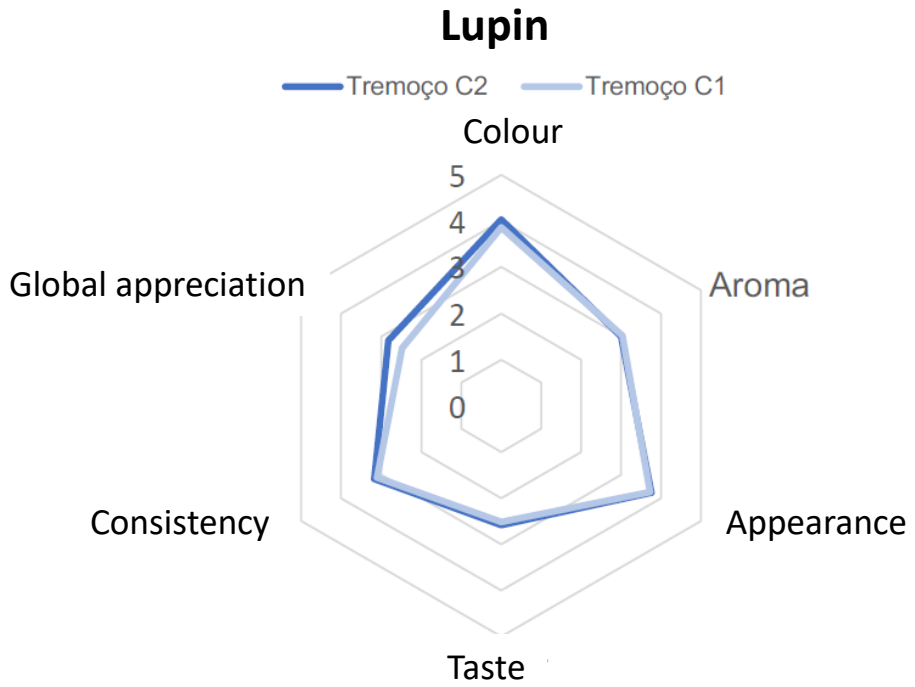


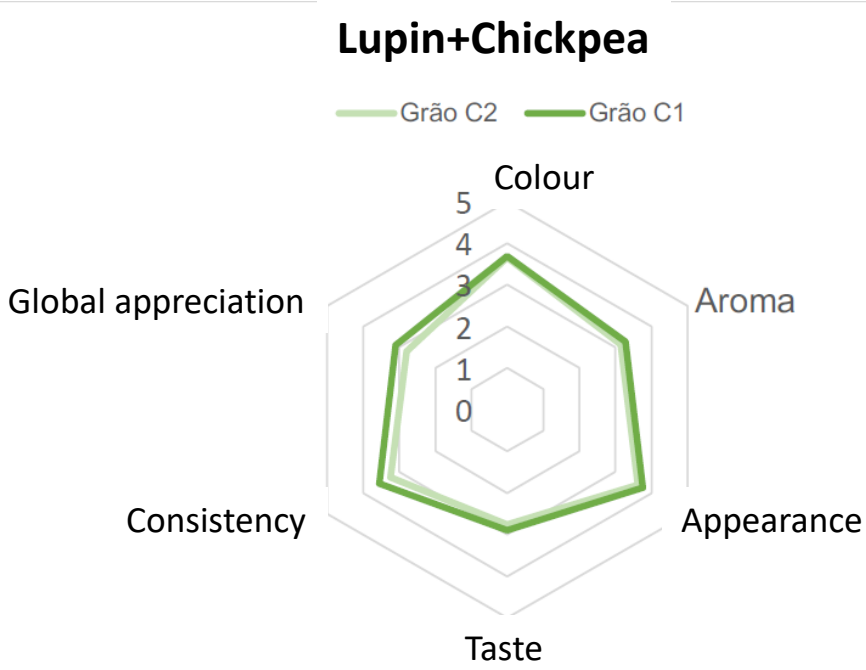
Chickpea-based beverages
Mineral contents - before and after in vitro digestion

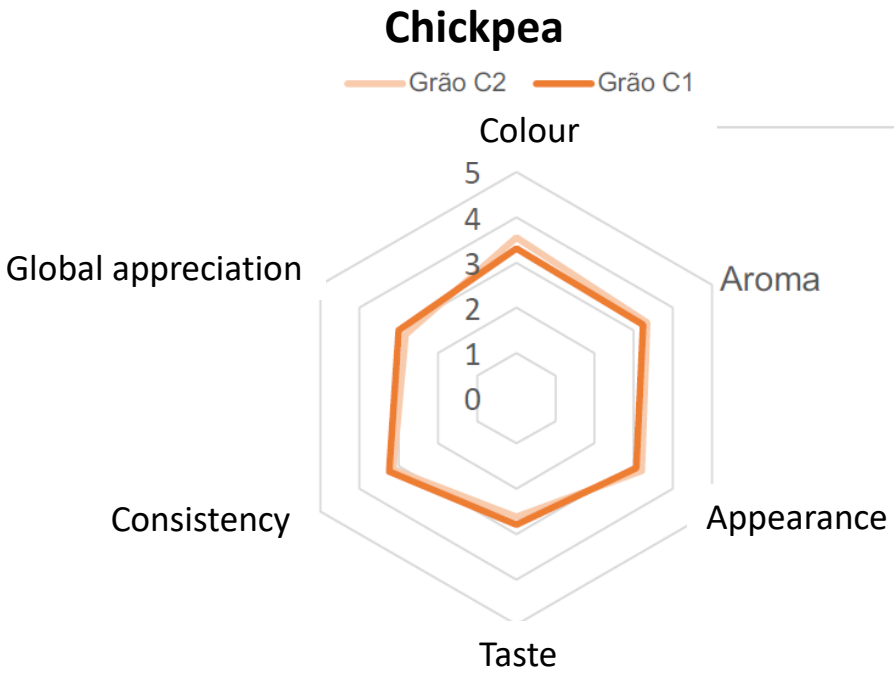



Chickpea alfa+amyloglucosidase
Chickpea amyloglucosidase
Chickpea alfa amylase
Lupin
Chickpea
Lupin + Chickpea
Skimmed milk
1E+4
1E+2
1E+0
1E-2
1E-4
Viscosity (Pa.s)
1E-6
1E-4
1E-2
1E+0
1E+2
1E+4
Shear rate (s-1)


Almond
Millet
Spelt
Hazelnut X
Coconut
Rice
Oat X
Soy
Skimmed milk
Low fat milk
Whole milk
Lupin B1 X
Lupin B2 X
Chickpea B1 X
Chickpea B2 X
Lupin+Chickpea B1 X
Lupin+Chickpea B2 X
Lupin A1 X
Lupin A2 X
Chickpea A1 X
Chickpea A2 X
Lupin+Chickpea A1 X
Lupin+Chickpea A2 X
GROUP X
GROUP Y
Viscosity (Pa.s)
1E+4
1E+2
1E+0
1E-2
1E-4
1E-6
1E-4
1E-2
1E+0
1E+2
1E+4
Shear rate (s-1)







Just the cooked seeds

No sugar

No salt

Conclusions

High (around 4%) digestible protein beverages can be produced from European pulses

Soaking and cooking eliminates the raw been flavor

Whole seeds produce a pleasant beverage with good mouthfeel (high viscosity)

No residues – ZERO WASTE

No need for salt, or sugar, or gelangum – CLEAN LABEL

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