Solubility and emulsifying properties of aqueous extracts and protein concentrate from African palm weevil larvae

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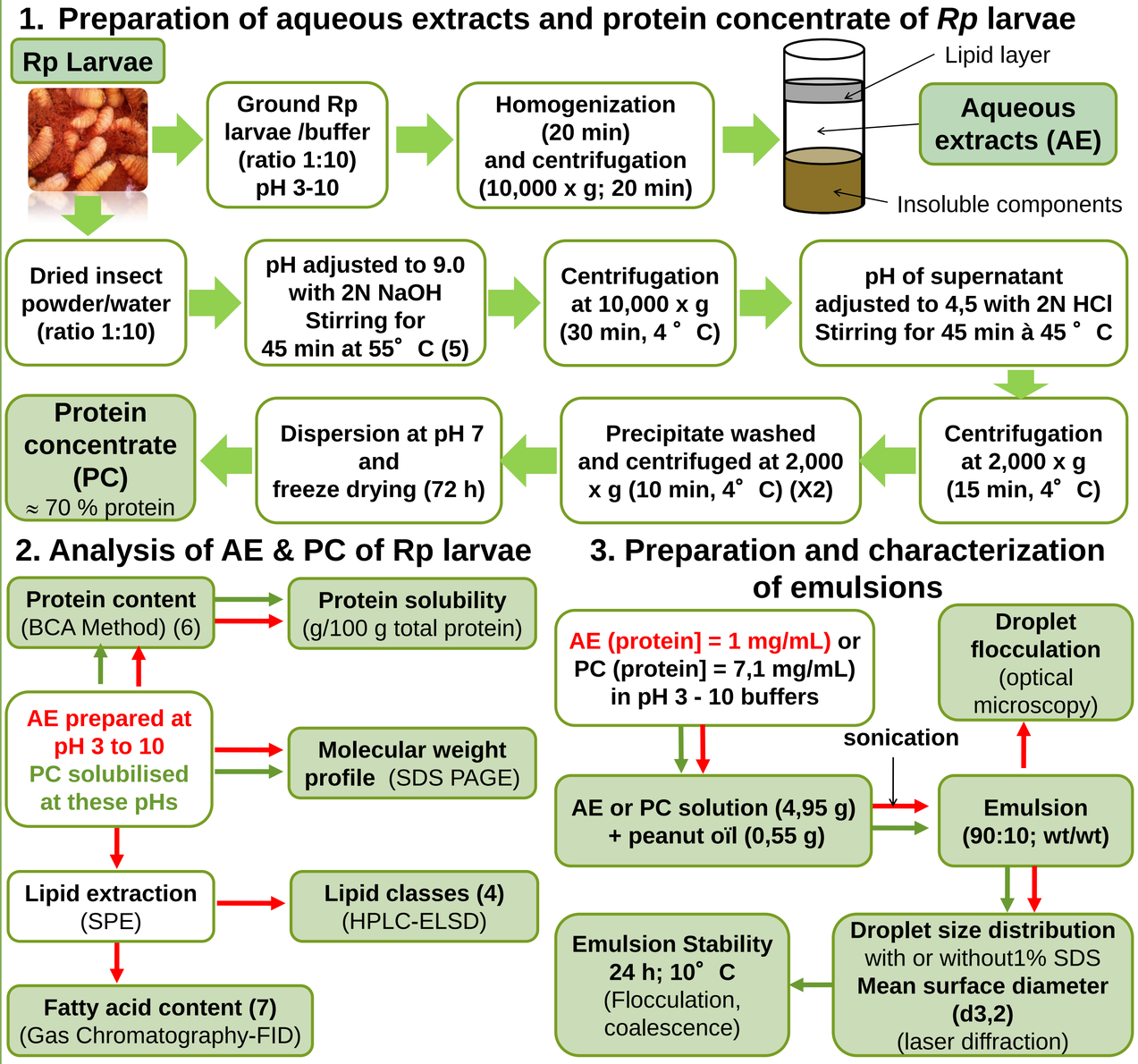
Introduction

Today, edible insects are evaluated for their potential to be used as food ingredients (1,2,3). The larvae of *Rhynchophorus phoenicis (Rp)*, edible insect eaten in Central and Western Africa, are a good source for proteins and unsaturated lipids (4). Now, they can be farmed which could be the opportunity for sufficient production at small-scale to medium level to provide a new source of protein ingredient for small-size formulation industries.

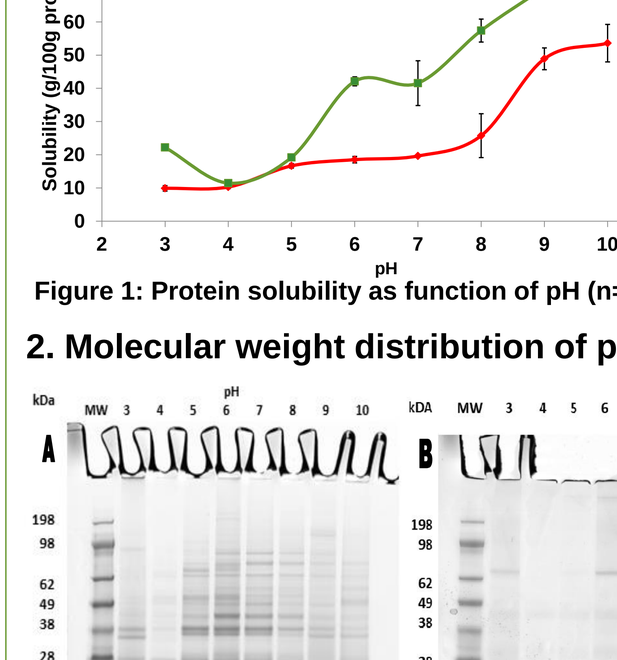
In the present work, the influence of pH on the emulsifying properties of aqueous extracts (AE) and protein concentrate (PC) of *Rhynchophorus phoenicis* larvae was studied.

Material & Methods

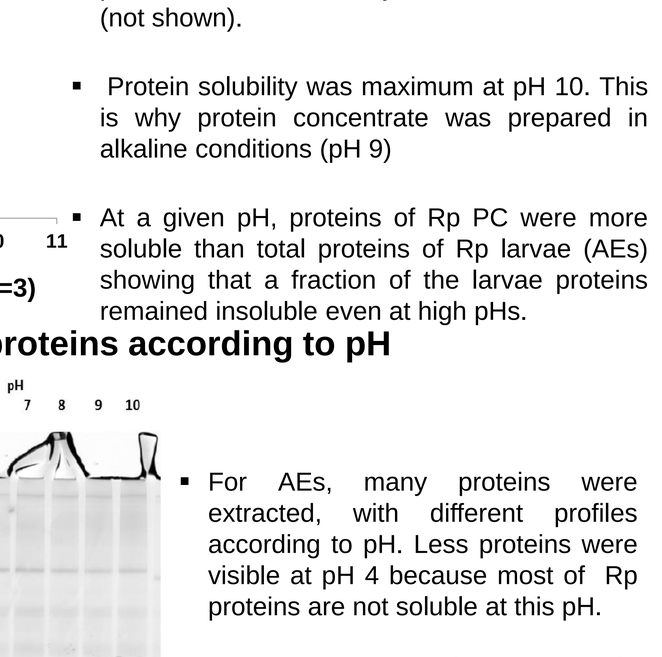
1. Preparation of aqueous extracts and protein concentrate of *Rp* larvae



2. Analysis of AE & PC of Rp larvae



3. Preparation and characterization of emulsions



Results & Discussion (1)

1. Effect of pH on solubility of proteins of Rp and Rp protein concentrate

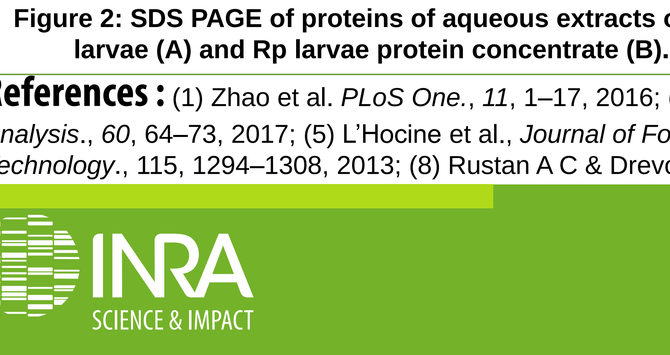


Figure 1: Protein solubility as function of pH (n=3)

- The protein solubilites of Rp (AE) and Rp PC increased with pH. They were minimum at acid pHs corresponding to the pI of most PC proteins as confirmed by isoelectrofocalisation (not shown).
- Protein solubility was maximum at pH 10. This is why protein concentrate was prepared in alkaline conditions (pH 9)
- At a given pH, proteins of Rp PC were more soluble than total proteins of Rp larvae (AEs) showing that a fraction of the larvae proteins remained insoluble even at high pHs.

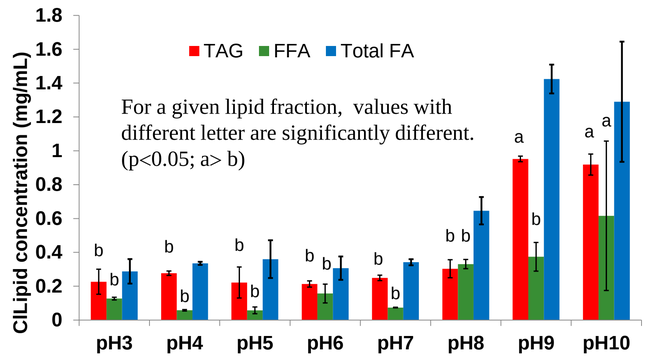
2. Molecular weight distribution of proteins according to pH

Figure 2: SDS PAGE of proteins of aqueous extracts of Rp larvae (A) and Rp larvae protein concentrate (B).

- For AEs, many proteins were extracted, with different profiles according to pH. Less proteins were visible at pH 4 because most of Rp proteins are not soluble at this pH.
- For Rp PC, apart for one protein band not present at pH 4.0 and 5.0, the profiles were similar whatever the pH.

Results & Discussion (2)

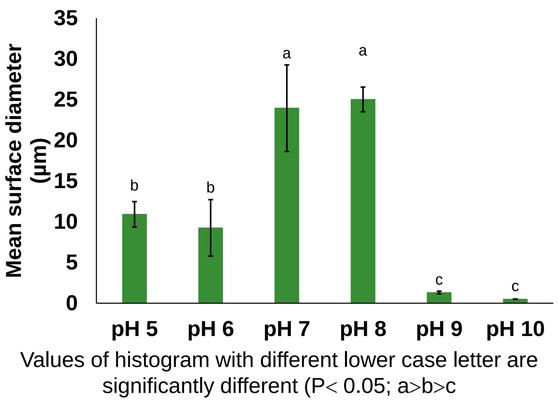
3. Lipid composition of Aqueous Extracts of Rp larvae at different pHs



- Lipids present in Rp aqueous extracts were mainly composed of triacylglycerols (TAG) and free fatty acids (FFA).
- Free fatty acids were majorly extracted at pH 9.0 and 10.0. They can result from lipid hydrolysis before (grinding of the larvae) or during preparation of aqueous extracts

Figure 3: Triacylglycerols, free and total fatty acid contents of Aes of *Rhynchophorus phoenicis* larvae prepared at different pHs

4. Droplet size and aggregation of emulsions stabilized by Aqueous Extracts of *Rp larvae*



Values of histogram with different lower case letter are significantly different (P< 0.05; a>b>c

Figure 4: d3,2 of the droplets of the emulsions according to extraction pH (n = 3)

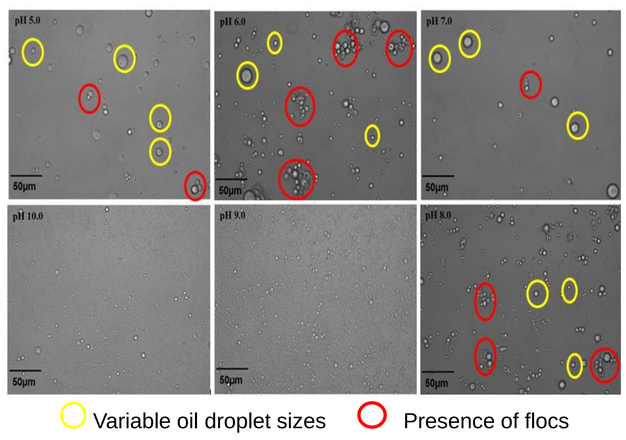


Figure 5: Microscopy of the emulsions prepared at pH 5 to 10

- At pH 5.0 to 8.0, presence of flocs and very large oil droplets (d3,2) > 9 µm), which led to unstable emulsions that creamed in less than 30 min after emulsification.
- At pH 9.0 and 10.0, the droplets were small : d3,2 < 1,5 µm, and no flocculation was observed. Emulsions had been stable for more than a week.
- At alkaline pHs, FFA (ionized) form alkali metal salts (soap), which have important properties as association colloids and are surface active agents (8)
- Proteins and free fatty acids extracted at alkaline pH contribute to provide emulsifying properties to AE.

5. Droplet size distribution of emulsions with Protein Concentrate of *Rp* larvae (with and without SDS 1%)

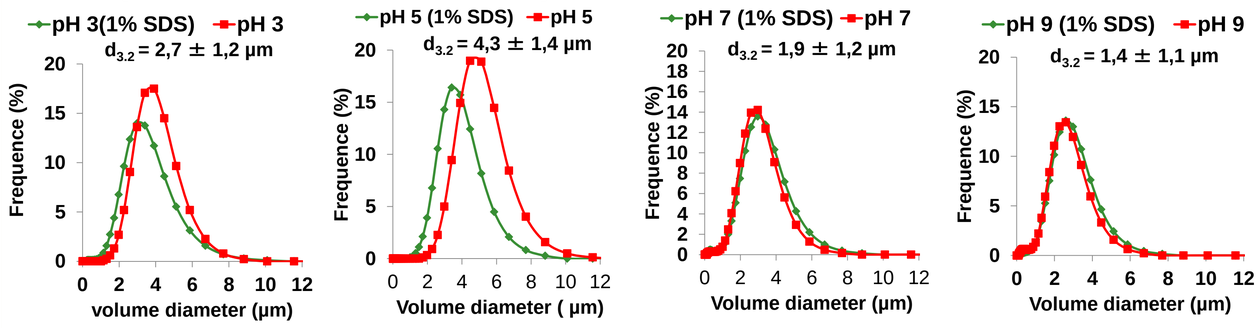


Figure 5: Distribution of emulsion size of protein concentrates of *Rhynchophorus phoenicis* larvae at different pH levels in the presence and absence of SDS

- Whatever the pH, with and without 1 wt % SDS, the droplet size distributions of the emulsions were monodisperse
- Fine droplet distributions and stability against flocculation and coalescence were observed at pH 3.0, 7.0 and 9.0, while the pH 5 emulsion was coarser and unstable

Conclusions

Aqueous **E**xtracts of *Rhynchophorus phoenicis* larvae prepared at pH 9.0 and 10.0 have, contrary to acid and neutral AEs, good emulsifying properties probably due to the presence of both free fatty acids and proteins. They could be used to emulsify and stabilize complex formulations. **P**rotein **C**oncentrate of *Rhynchophorus phoenicis* larvae was able to form emulsions with small droplet size at studied pHs. *Rp* protein concentrate can be used to prepare emulsions for food applications.

References : (1) Zhao et al. *PLoS One.*, *11*, 1–17, 2016; (2) Yi L. et al. *Food Chemistry*., 141, 3341-3348, 2013; (3) Bußler et al., *Heliyon.*, *2*, 1 – 24, 2016; (4) Fogang Mba et al. *Journal of Food Composition and Analysis*., *60*, 64–73, 2017; (5) L'Hocine et al., *Journal of Food Science*, *71*, 137–145, 2006; (6) Smith et al. *Analytical Biochemistry*., 150, 76-85, 1995; (7) Kabri TH et al. *European Journal of Lipid Science and Technology*., 115, 1294–1308, 2013; (8) Rustan A C & Drevon C. *Encyclopedia of Life Science.*, 1–7, 2001

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Acknowledgments: Service de Coopération et d'Action Culturelle de l'Ambassade de France (Yaoundé, Cameroon) for travel allowance