Evaluation of the oxidative stability of a bigel system using natural antioxidants

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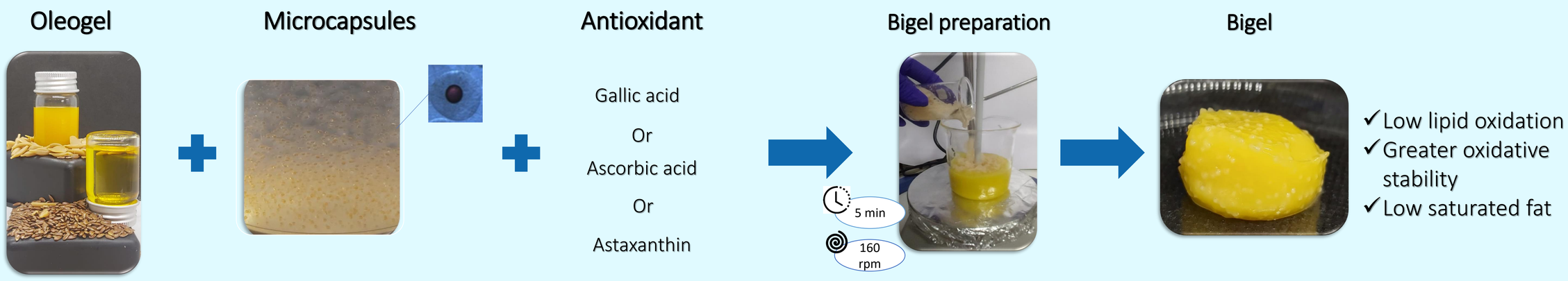
1. INTRODUCTION AND OBJECTIVE

Bigels are a new solid-like formulation produced from the combination of an oleogel and a hydrogel. This study evaluates the antioxidant effect of gallic acid, ascorbic acid, and astaxanthin on the oxidative stability of a bigel (oleogel/microcapsule) system.

2. METHODOLOGY

The bigel was prepared with an oleogel (beeswax/shellac waxed 70/30 (% w/w) and linseed oil) mixed with microcapsules (sodium alginate/shellac dewaxed 95/5 (% w/w) and sunflower seed oil) in a proportion of 80/20 (% w/w), respectively. Astaxanthin was incorporated into the lipid phase, and gallic acid and ascorbic acid into the hydrophilic phase of the microcapsules. The effect of each antioxidant on oxidative stability was evaluated using the Rancimat test (induction time) and lipid oxidation using the peroxide index.



3. RESULTS

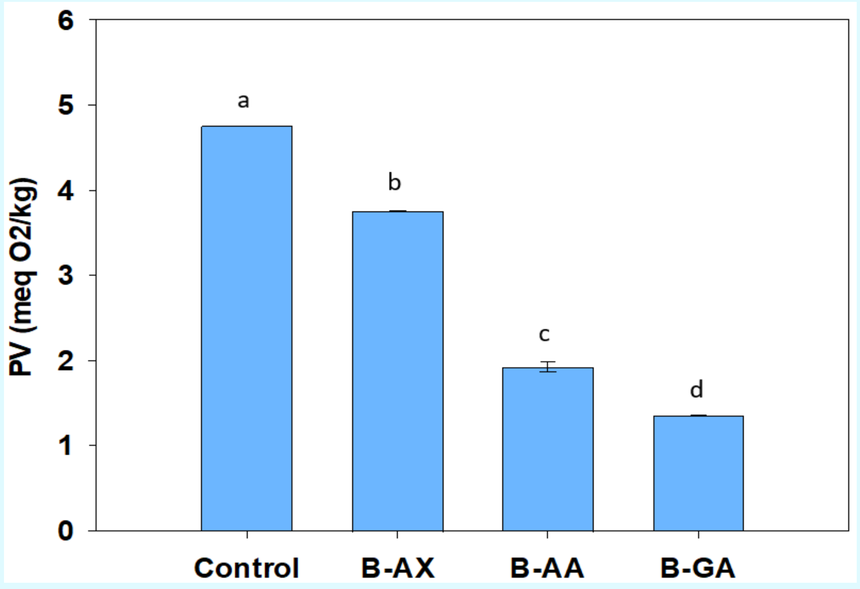


Figure 1. Oxidation of bigels (Peroxide value, PV) with antioxidants where B-AX: bigel with astaxanthin; B-AA: bigel with ascorbic acid and B-GA: bigel with gallic acid. Control is a bigel without antioxidants. Different letters above each bar indicate significant difference

The PV showed that all the antioxidants significantly decreased ($p<0.05$) the oxidation of the bigels during processing. Therefore, the bigels with antioxidants were more stable to the formation of primary oxidation products. In addition, the PV of the bigels was well below the maximum value allowed by international standards (up to 10 meq O2/kg of oil).

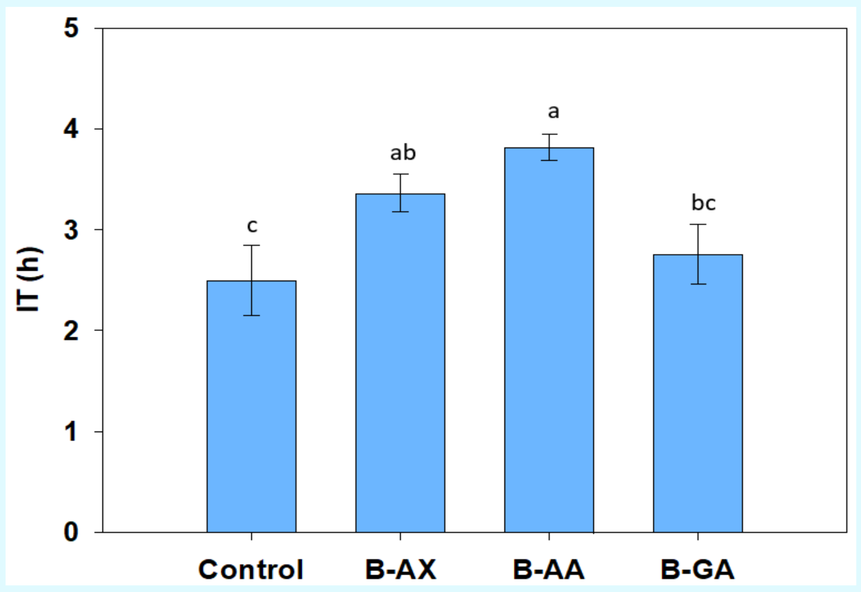


Figure 2. Oxidative stability (induction time, IT) of bigels with antioxidants where B-AX: bigel with astaxanthin; B-AA: bigel with ascorbic acid and B-GA: bigel with gallic acid. Control is a bigel without antioxidants. Different letters above each bar indicate significant difference

The result showed that B-AX and B-AA presented a significant difference ($p<0.05$) compared to the control, increasing the induction time by 0.86 h and 1.32 h, respectively. This indicates that astaxanthin and gallic acid significantly enhance the oxidative stability of bigels.

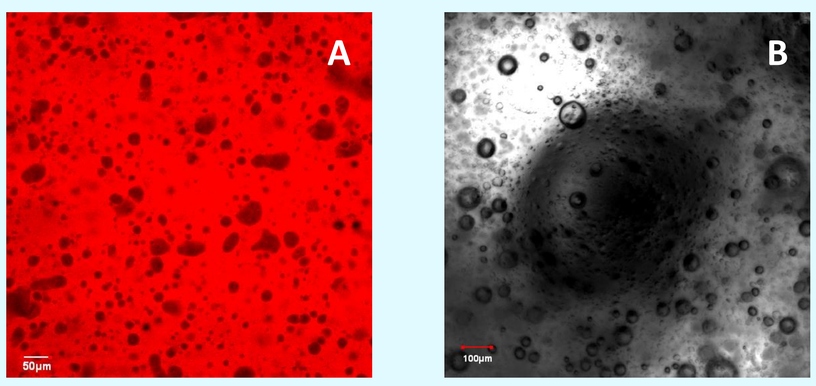


Figure 3. Confocal microscopy images of oleogel (A) and bigel (B)

Figure 3A shows the lipid component in red, and crystal formation is displayed in black. The oleogel exhibited platelet-like crystals homogeneously distributed throughout the oleogel structure (Figure 3B), showing alginate/shellac microcapsules incorporated into the oleogel to form the bigel.

4. CONCLUSIONS

According to these preliminary results, lipophilic and hydrophilic antioxidants indicate promising applications in this novel structured oil based on oleogels and hydrogels as microcapsules with an antioxidant delivery system.

ACKNOWLEDGMENTS

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