Functional properties of fermented soy seasoning supplemented with *Tenebrio molitor larvae*, *Protaetia brevitarsis larvae*, and *Gryllus bimaculatus* powder

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Abstract

As a sustainable protein source, an edible insect has a high nutritional value, including amino acids related to flavor enhancement. In this study, fermented soy seasoning was prepared using edible insects. The fermented soy seasoning was produced by combining soybean, okara, and three different edible insect powder: *Tenebrio molitor* larvae (TSF), *Protaetia brevitarsis larvae* (PSF), and *Gryllus bimaculatus (*GSF*)* in a 4:3:3 ratio and inoculated with 1% *Aspergillus oryzae.* The mixture was then fermented at 28°C and 80% humidity for two days. Quality properties (salinity, total nitrogen), isoflavone content, and antioxidant activity were investigated. The salinity of edible insect-added fermented soy seasoning ranged from 1.7% to 2.4%. The total nitrogen content (GSF 9.03%, TSF 8.88%, PSF 8.12%) all met the fermented seasoning standard (5.6%). Isoflavone content was highest in PSF (0.215 mg/g), followed by GSF (0.182 mg/g) and TSF (0.118 mg/g). DPPH activity (TSF 61.76%, GSF 58.53%, and PSF 51.30%) showed the opposite trend. Overall, the supplementation of fermented soy seasoning with insect powders can enhance its functionality, making it a potential nutrient source.

Introduction

Edible insects are used as a source of animal protein, essential amino acids, and micronutrients. Edible insects can vary in nutritional content depending on the species and habitat. However, they generally have a high protein content of around 50-60% of their dry weight, making them an important source of quality protein. It is expected that high-quality protein sources like edible insects can increase protease activity during fermentation, leading to the production of a large amount of amino acids. In particular, the addition of fermentation agents such as okara is anticipated to influence the growth and reproduction of microorganisms, especially *A. oryzae* and *B. subtilis*, through solid-state fermentation. Therefore, in this study, we used *Tenebrio molitor* larvae, *Protaetia brevitarsis* larvae, *Gryllus bimaculatus* as representative edible insects, along with *A. oryzae* strains, to form fermented soybean paste (meju) by mixing them with soybeans and okara. We evaluated the functionality of the resulting meju powder.

Materials and Methods

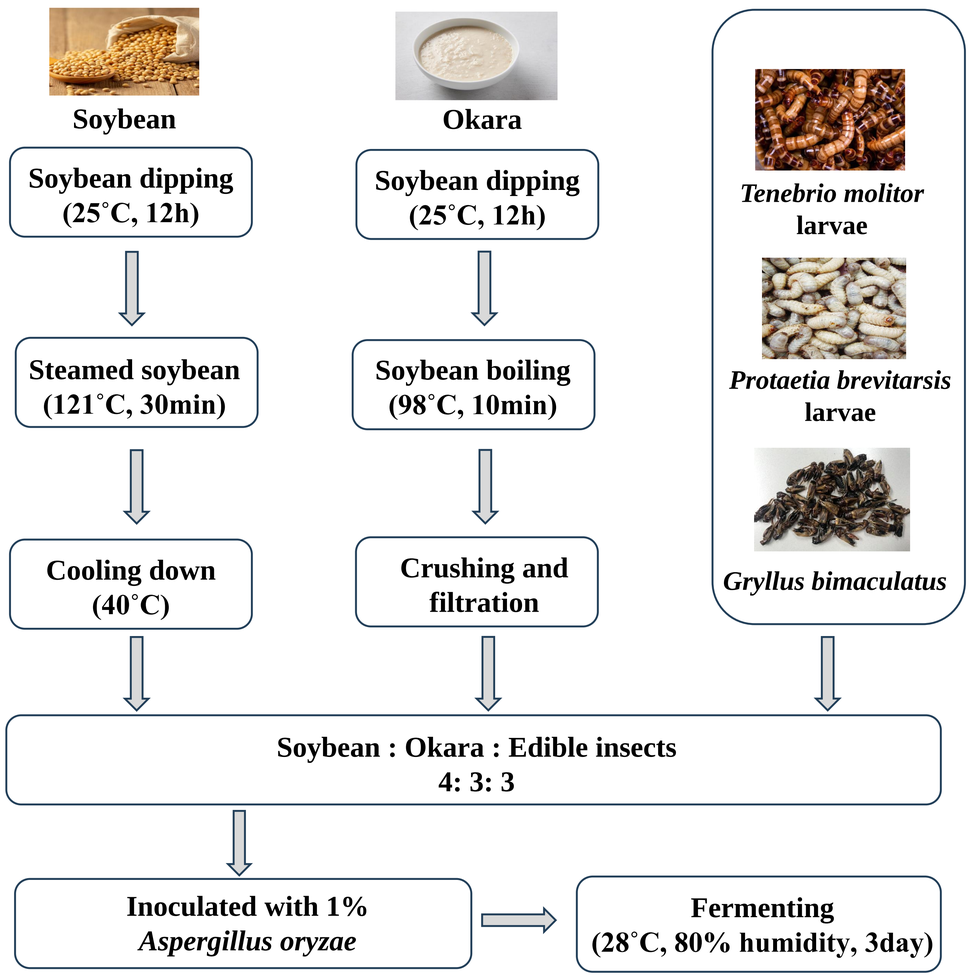

Fig 1. Flow chart showing production of edible insect fermented seasoning

Quality & Functional properties

- Total nitrogen & salinity
- Antioxidant capacity: Total phenolic content, DPPH & Isoflavone
- Antidiabetic ability : α-glucosidase

Results

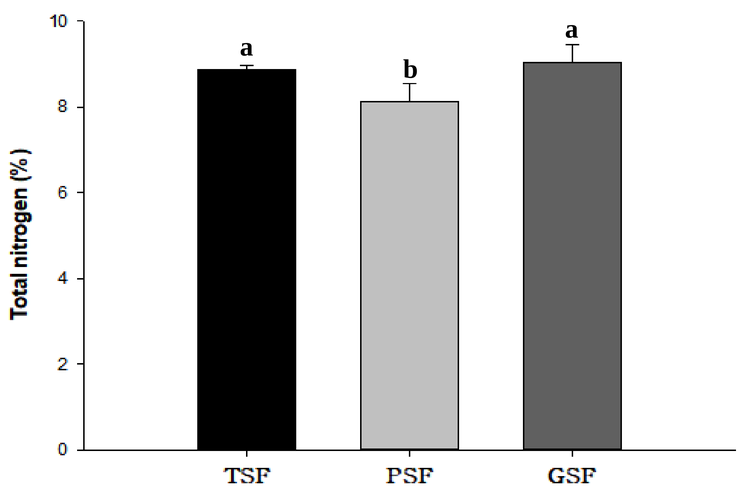

Fig. 2. Total nitrogen of insect-meju powder

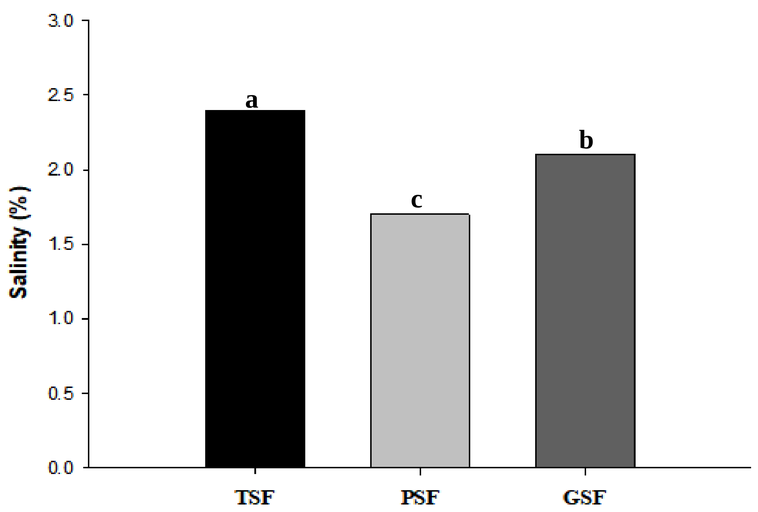

Fig. 3. Salinity of insect-meju powder

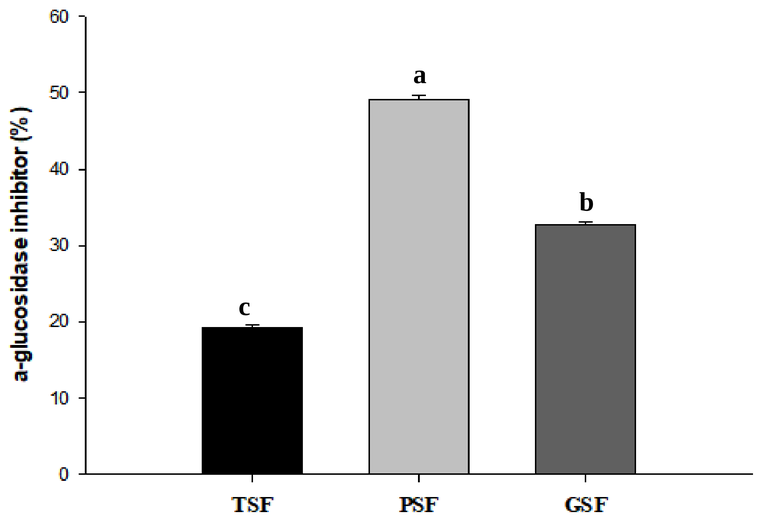

Fig. 4. α-glucosidase inhibitor of insect-meju powder

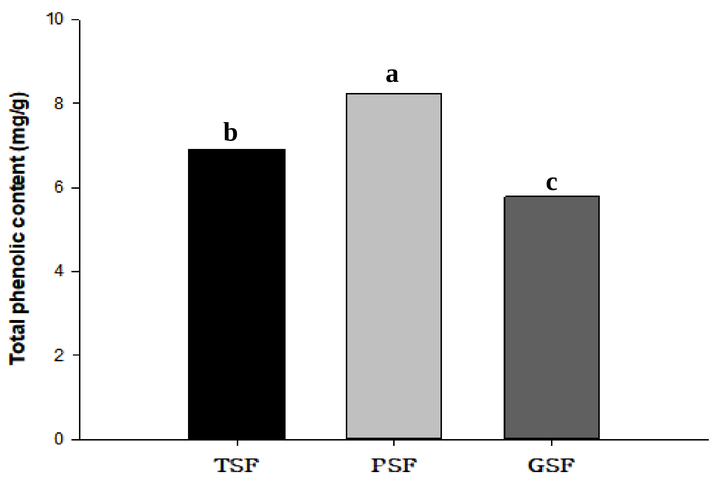

Fig. 5. Total phenolic contents of insect-meju powder

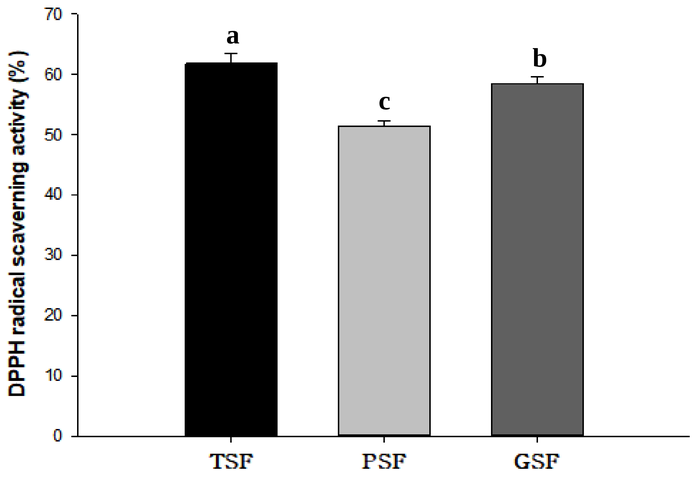

Fig. 6. DPPH radical scavenging activity of insect-meju powder

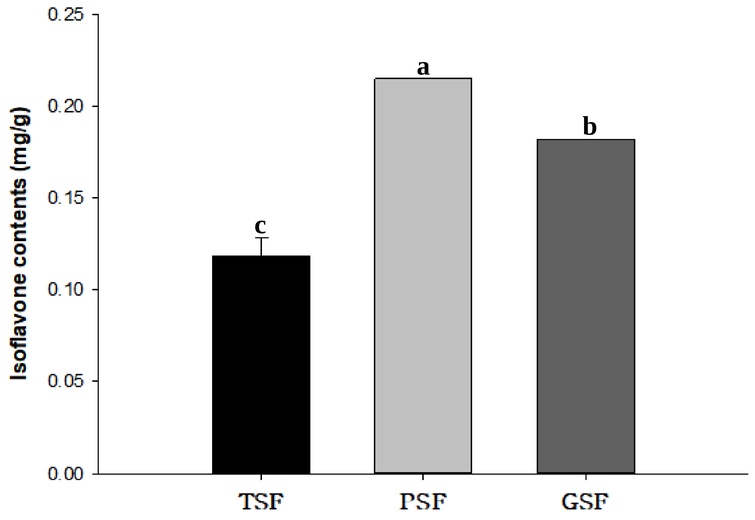

Fig. 7. Isoflavone contents of insect-meju powder

TSF: *Tenebrio molitor* larvae fermented with soybean and okara; PSF: *Protaetia brevitarsis* larvae fermented with soybean and okara; GSF: *Gryllus bimaculatus* feremented with soybean and okara.
[a-c] Superscripts indicate significant differences demonstrated by Duncan's test (p<0.05) between three samples.

Summary and conclusion

- The total nitrogen content was GSF(9.03%), TSF(8.88%), and PSF(8,12%), which met the total nitrogen standard of 5.6% in soybean paste.
- PSF (0.215mg/g and 49.15%) showed the highest isoflavone content and antidiabetic ability, followed by GSF (0.182mg/g and 19.23%), and TSF (0.118mg/g and 32.74%)
- PSF showed the highest value of total phenolic contents, whiles TSF showed the highest value of DPPH activity
- Edible insects can be used as a new ingredient for fermented seasoning, particularly, fermented seasoning using *protaetia brevitarsis* larvae in terms of functionality.

Ackowledgement

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