**Production of a fungal fermented product as a meat substitute**

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**Highlights**

* Food residues is converted by an edible fungi into a high protein meat replacer.
* The fungal product contain 29 % protein and 0.8 mg/g carotenoids.
* The product showed textural similarities with hamburgers and non-meat products.

**1. Introduction**

By 2050 world population is set to increase to over 9 billion. In order to feed this larger and wealthier population, food production foresees to rise by 70%. Access to a healthy and sustainable diet will become more important than ever as the planet accommodates for increased population. In this context, the present study presents a way to biotransform food residues into a valuable food product with promising attributes to substitute meat products. The edible filamentous fungi *N. intermedia* was used to create a fungal burger with stale bread and brewers spent grain as substrate. Since more than one billion people worldwide is unable to meet their daily protein requirement [1, 2] and texture is one of the biggest barrier to widespread acceptance for meat alternatives [3], the product was mainly evaluated based on its protein and texture attributes.

**2. Methods**

Fungal fermentation of the edible food grade filamentous fungi *Neurospora intermedia* CBS 131.92 (Centraalbureau voor Schimmelcultures, The Netherlands) was carried out in sterile petri dishes with bread crumbs alone or addition of brewers spent grain were used as substrate. Total 15 g substrate was inoculated with 1 ml spore suspension of *N. intermedia* separately for each petri dish and initial moisture content was adjusted to 40% (on a dry basis (w/w, db). Solid state fermentation was carried out batch wise for 6 days in a climatic test cabinet (NUVE test cabinet TK 120, Turkey) at 90-95% Rh at 35 °C under light. All the cultivation experiments were conducted in duplicate except for texture analysis where six replicates were made, and the mean values are presented with standard deviations. The textural profile analysis (TPA) of the samples was assessed with a TVT 6700 texture analyser (Perten Instruments, Sweden with software TexCalc version 4.0.2.50). To simulate a bite force through the burgers, a heavy Duty Stand, a knife blade probe with holder and blade set was attached. The maximum force required to break the sample was compared between samples. Instrumental texture measurement of the fermented fungal burgers was investigated after frozen samples for 24 h followed by frying at 100°C in 2 g of canola oil for 10 minutes.

**3. Results and discussion**

Bite force was measured by shearing with a knife blade to simulate a human bite and ease of chewing through the sample. As expected, the maximum force increased overall with increasing BSG concentration in the substrate. Texture analysis on *N. intermedia* fungal burgers produced from stale sourdough bread with 0 % addition of BSG revealed a similar bite force response when fried as hamburger whereas addition of 10 % BSG was needed to reach a similar bite force response as a commercial soy burger, Figure 1. The objective textural data contribute to important knowledge about the products quality attributes. The stale bread with 10 % BSG used as substrate was converted into a high protein and nutritional fungal burger where mostly carbohydrates were converted into protein by *N. intermedia*. This fungal burger resulted in a protein increase by 152 % by *N. intermedia*. The increase in protein content is largely explained by a decrease in dry weight content of the fermented material [4]. Moreover, the fungal burger contained 0.95 mg carotenoids/g total material.

**Figure 1.** Bite force test of pre-frozen and fried fungal burgers and reference hamburger and soy burger available on the market. Fungal burgers are made from stale sourdough bread + 0, 5 or 10 % brewers spent grain using *N. intermedia* after 6 days solid state fermentation under light at 35 °C, 90 % Rh, and 40 % initial moisture content. Results are expressed as the mean value ± standard deviation.

**4. Conclusions**

The fermented fungal burger made from stale bread and up to 10 % brewers spent grains present an opportunity for an meat substitute. With up to 36 % protein and similar texture attributes to commercial products on the market, the product present a great addition to a modern diet without over-exploiting natural resources. The additional pigments produced (0.95 mg carotenoids/g total material) in the final product further adds value to the protein-rich fermented product.

**References**

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