Improving the quality of pearl millet and wheat flour composite bread by optimizing process parameters

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Introduction

- Bread is commonly made from wheat flour
- Challenges such as low yield, unable to resist drought, and low pest resistance of wheat production in developing countries (global south).
- Millets which are underutilized cereals can overcome the above-mentioned challenges and used to make bread by mixing with wheat flour.
- Millets has issues due to the presence of antinutrients (phytate and tannin) which bind essential minerals including Iron and Zinc.
- The aim of this study is to see the effect of germination on nutritional, antinutrients content and quality of composite flour bread.

Methods

- Pearl millet (Kola-1; accession number: ICMV221) was germinated by varying the germination time (1, 2, and 3 days) and germination temperature (25, 30, and 35 oC).

- The effect of flour sieve size (150, 250, and 350µm) and mixing ratio of pearl millet flour with wheat (0, 10, 30, and, 50%) on antinutritional components and quality of bread were analyzed.
- The proximate composition, antinutrients, functional properties and sensory analysis of bread were analyzed and from the results, the conclusions were drawn.

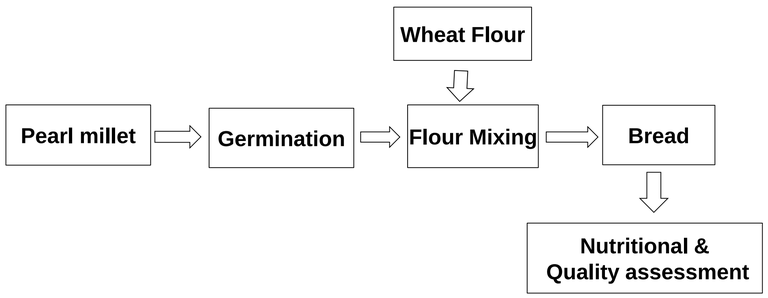

Fig. 1. Schematic diagram of bread development from wheat, germinated pearl millet and quality parameter analysis

Results

- The protein content of raw and germinated pearl millet was found to be 11.4% and 13.9%, respectively.
- The increase in protein content in the germinated pearl millet could be attributed to enhanced bioavailability of proteins during germination.
- Germination reduced the lipid content, which might be due to hydrolysis and the utilization of fats as an energy source for biochemical reactions.
- Germination enhances the fiber content of pearl millet ,due to the degradation of dry matter through enzymatic hydrolysis of starch and microbial breakdown of carbohydrates, proteins, and fats and formation of cellulose, lignin, and hemicellulose from crude fiber, and synthesis of various cellular components in plant cells.
- Germination improves the functional and sensory values of bread samples.

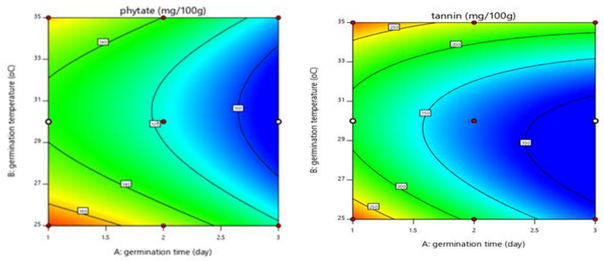

Fig. 2. Germination time and germination temperature effect on phytate and tannin content of pearl two-factor interaction contour plot.

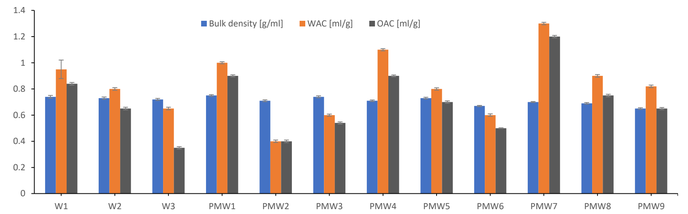

Fig. 4. Functional properties of different composite flour (PM to wheat).

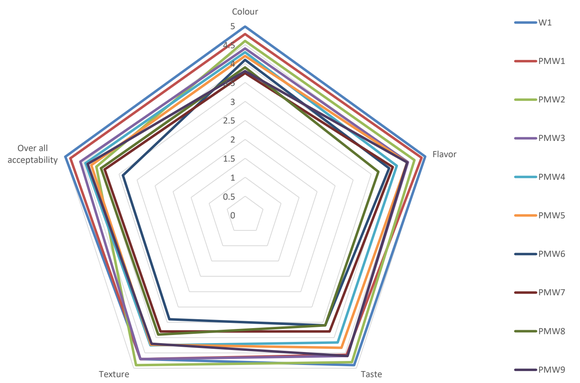

Fig. 5. Mean scores of the sensory evaluation of pm-wheat composite bread.

Conclusions

- The optimal germination time and temperature were (3 days and 30°C)
- Optimum mixing ratio (1 pearl millet: 9 wheat flour) and particle size of flour were 150µm
- Germination reduces the phytate (by 86.1%) and tannin content (by 74.6%).
- Antinutrients reduction expected to enhance bioaccessibility of minerals in digestion process.

- WAC and OAC increased with a increasing pearl millet flour will bulk density decreased
- .Overall acceptability of bread samples were above 3.39 on seven hedonic scale.
- Pearl millet has a potential to alleviate the hidden hunger in developing countries.

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Key to Abbreviations:
W1=wheat at 150 µm sieve size, W2=wheat at 250 µm , W3=wheat at 350 µm, PMW1=pearl millet to wheat 10:90 at 150µm, PMW2=pearl millet to wheat 10:90 at 250µm, PMW3=pearl millet to wheat 10:90 at 350µm, PMW4= pearl millet to wheat 30:70 at 150µm, PMW5=pearl millet to wheat 30:70 at 250µm, PMW6= pearl millet to wheat 30:70 at 350µm, PMW7= pearl millet to wheat 50:50 at 150µm, PMW8= pearl millet to wheat 50:50 at 250µm, PMW9= pearl millet to wheat 50:50 at 350µ ; WAC-Water Absorption index; OAC- oil absorption index