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General Conclusion and Recommendations for the Significance of Sesame Seed (Benni Seed) as a Health Complementary Food

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General Conclusion

Sesame seeds have been utilized in most developing countries purely for just its oil content. Most times the remaining materials after the oil has been extracted will be discarded or given to animals as feed. The discarded "waste" as it is regarded in those places contains unique protein that could be utilized as a protein supplement for food that requires high protein content. In this regard, to fully utilize the whole sesame seeds, various methods were investigated to extract protein from defatted sesame flour. After selecting the best method that also gives the best attributes to the protein extracted it was then supplemented into rice flour with other raw materials as complementary food for infants.

Several objectives were set and they were successfully achieved as follows;

1. Water was used to extract the protein from the defatted sesame flour through the use of response surface methodology (RSM). During that investigation critical values were proposed by the model design that gave the highest protein extraction which was not too high as expected and also the amino acids content was also observed to be low. The defatted sesame flour was fractionated to investigate why the protein recovered was low during the RSM process; the results observed supported the RSM results. Also protein treated at pH 10-12 is likely to form Lysinoalanine which has long been known to cause kidney damage (Niphrotoxic). In that regard another method of protein isolation was investigated to know which method could be utilized to extract the highest protein content with higher amino acid contents from defatted sesame flour that could be utilized as safe protein supplement for different food systems.
2. Different proteases were screened and Alcalase2.4L was selected as its gave the highest protein recovery as compared to the other enzymes and low free amino acid groups. Protein hydrolysate was produced from defatted sesame flour using the critical values of the different conditions studied to have an optimum degree of hydrolysis after Alcalase2.4L has been selected. RSM was also used to investigate the degree of hydrolysis (DH), which ranged from 1.19 to 18.8 %. The second order model showed a good fit, the adjusted coefficient of determination (R^2 adj), which can check the appropriateness of a model was 0.9870. This implies that the sample variation of 98.70% for the hydrolysis of defatted sesame flour was attributed to the independent variables that could be explained by the model within the range of values studied. The data proved that the developed model could adequately represent the real relationship among the parameters chosen to be studied. This made this method to be selected for further investigation to see the appropriateness of the protein extracted as protein supplement into a complimentary food for infants.
3. The effects of the enzymatic hydrolysis with Alcalase 2.4L on the amino acid content and functional properties of the protein hydrolysate from defatted sesame flour was investigated. It was observed that the functional properties of the three hydrolysates (DH1, DH2 and DH3) were significantly different ($p< 0.05$) to those of the native protein of defatted sesame flour that is the one extracted by water. An increase was observed for all the functional properties investigated from DH 1 to DH3 as compared to the native protein of the defatted sesame flour. The colour and molecular weight which were also investigated vary according to the various levels of DH, while the amino acid content of the defatted sesame protein hydrolysate differs significantly ($p< 0.05$) from that of the native defatted sesame protein and the essential amino acids are higher than the required amount of FAO/WHO for both infants and adults. The *in vitro* protein digestibility (IVPD) and some nutritional indices were observed to be higher in the hydrolysate than in the DSF.

4. The problem most times observed after the hydrolysis process using Alacalse 2.4L was the product to contain some bitter properties. To correct that problem, a simple and less expensive process to debitter and desalt the hydrolysates got from defatted sesame flour was done. The bitter and salty tastes were removed with macroporous resin (MAR) to absorbed the hydrolysate and various Alcohol concentrations (AC) were used desorbed the hydrolysates from the MAR. 25% AC was tasteless, 50% AC showed mild bitter taste while the 60% AC was still bitter. After the debittering and desalting processes ash was significantly reduced while protein content was improved. The hydrolysates got from 50% AC, showed superior ACE inhibition with the highest IC50 followed by 25% AC and 60% AC. For the molecular weight distribution of the three products, the short peptides moved to a stronger hydrophobic group which is the AC 60. AC60 shows higher amino acids with distinct hydrophobic properties. The 60% AC was bitter but could be utilized in another industry as it contains significant amount of amino acid content. The bitterness could be masked or put in a film of microencapsulation that will conceal the bitterness.
5. After the hydrolysate was successfully debittered and desalted, a complementary food product for infant was formulated and utilized debittered and desalted hydrolysates as protein supplements. The formulation was done to ascertain if the protein hydrolyzed and debittered and desalted could be utilized successfully as protein supplement to rice flour and other raw materials. The product possesses good biochemical and physicochemical properties. This could help developing countries that have been utilizing sesame just for the oil and throw away the remaining materials which contain high valuable protein content. This will bring hope to those countries as it will help them to reduce the incidence of infant protein/energy malnutrition. In an overall conclusion, the isolation/extraction of protein from defatted sesame flour should be encourage as the protein contains good nutritional attributes that could be utilized in other food formulations as protein supplements.

Recommendations

The present study has shown that it was possible to extract protein from defatted sesame flour by using Alcalase 2.4L. the protein extracted shows good nutritional and functional properties and after debittered and desalted it could be utilized as protein supplements in a rice flour and formulated as complementary food for infants. Despite the above achievements, the following are recommended to enhance the full utilization of the whole sesame seed;

1. Study the chemical interaction of the food (protein and carbohydrate) that will take place after the protein extract has been incorporated in the rice flour as a complimentary food formulated.
2. Since the protein was extracted through the use of enzymes (Alcalase 2.4L.), the need for a study to determine the bioactive peptides developed, with properties to improve disease prevention and contribute to the general consumer (infant) health as other protein hydrolysates derived from other products.
3. Investigate on how to conceal the bitter taste (either by using a film of microencapsulation) of the hydrolysates got from 60% AC, as that hydrolysates contain significant amount of EAAs that could be utilized by the human system and also investigate how to improve on the mild taste experienced from the hydrolysates of 50% AC.
4. Conduct an animal test to verify all the good attributes ascribed to the hydrolysates isolated.
5. Study a cheaper packaging system that will be very suitable for the product that will conserve the food for a longer shelf life. The need to utilize the present nanotechnology is an area that could be extensively investigated to see how that technology could be utilized in the packaging process of this product.
6. Investigate the maximum temperature the food is to be kept for proper conservation of the nutrients of the food.
7. Trial tests to infants and mothers for acceptability should be conduct on the complimentary food formulated that was supplemented with the protein extracted from defatted sesame flour. As the organoleptic tests carried was done with students which their own preference might be different from those of the infants and mothers
8. Even though the molecular weight got was not within the bracket that will illicit allergens but studies should be conducted to ascertain that to the beneficiary. For now the food could be eaten by people who are sure that they are not allergic to sesame products.