

Optimization of Rapeseed Cake Fermentation for Food Industry

Masterarbeit am Fachgebiet Agrartechnik

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Summary

The need for cheap protein for worldwide increasing population can be met only with proteins from plant sources. There have been many evidences that demonstrated soybean tempeh fermentation process as one alternative technical way that can be used to convert the protein rich plant product into human quality food as meat protein substitute. The resulted meat substitute plant products after tempeh fermentation process are also easily digestible, nutritionally adequate, and inexpensive.

Other than soy bean many other substrates can be used in tempeh process and so it can be assumed that the principle of the tempeh process is suitable for the modification of a variety of substrates into acceptable products. This versatility of the tempeh process has great advantages to substitute with other possible protein rich substrate instead of soybean according to locally preferred and abundant raw materials.

Rapeseed is one of the interesting crops as protein rich substrate because rapeseed proteins have good functional properties and also it possesses reasonably well balanced amino acid content.

The development of biodiesel production involves the increased production of defatted rapeseed meal. Consequently, using rapeseed meal has been considered for human nutrition other than the current usage of animal feed and fertilizer supplement. There might be nutritional benefits by the production of tempeh-like rapeseed cake product with acceptable human consumption level through the tempeh fermentation process. On the other hand tempeh-like rapeseed cake production would make great benefit for the food industry to produce a value added by-product.

Therefore, technical optimization on rapeseed cake fermentation to produce tempeh-like rapeseed cake for human consumption become interesting subject for the production of protein rich meat substitute to prevent malnutrition on the continuous rising world population.

In tempeh fermentation process *Rhizopus oligosporus* fungus growth is important because the end product should be completely knitted with the fungus. Soybean tempeh is harvested when fungal mycelium knit into the soybean cotyledons into a compact cake. Similarly, in rapeseed cake tempeh well fungus growth is also important to get a complete quality end product.

In this experiment to improve aeration within the substrate rapeseed meal particles during fermentation process, some creations are made from the normal form plane cake. One is; cakes are perforated by making holes manually and the other one is; cakes are modified by binding together rapeseed meal small cylindrical pieces which are created by grinding machine.

Then, enquiry on fungus growth is made by taking photos as soon as the fungus growth is started to be visible and continue from time to time to evaluate the fungus growth behaviour of different rapeseed cakes (plane cake, perforated cake and modified shape cake). Moreover, the fermentation time needed to completely cover the cakes with fungus is also investigated to examine the best fungus growth rate. The time duration needed to reach the end point of the fermented cake is also analysed to determine the harvesting time before sporulation of the fungus *Rhizopus oryzae* is occurred. Finally, the fungus growth condition inside the cakes is examined and then these overall results are used to determine the best way that can optimize the fermentation of rapeseed cake.

Summary on the experimental results shows that creating the cakes with small cylindrical pieces and inoculating the fungus by mixing should be considered as an alternative applicable way in order to optimize the fermentation of rapeseed cake. On the other hand, fungal growth behavior and the end point of fermentation are also examined by the lightness parameter L^* of fermenting cake in this experiment as one more task. But the results show that the evaluation of fungus growth behaviour and end point based on lightness parameter L^* measurement is likely to be possible as useful way according to theoretical concept. But practically it has some limiting factors to examine fungus growth rate and behavior.

Rapeseed cake fermentation to produce tempeh-like end product for human consumption is still on the beginning of investigation. For commercial production as consumer acceptable level further experiments are still needed to assess the effect of fermentation on various chemical and antinutritional factors in respect to its safety and health aspect to become a guaranteed wholesome rapeseed tempeh product. For the marketability of the product research on economic significance and sensory factors such as appearance, texture, and flavour are also needed.

At the same time, the process engineering aspects such as monitoring, control and modelling of the fermentation on rapeseed cake and energy requirement at a large scale should be considered as an investigation challenges to achieve the industrial scale production on tempeh like rapeseed cake for human consumption. Future development of this new fermented food tempeh-like, rapeseed cake commercial production depends on the researchers willingness for further more experiments in respect to its safety and health aspect and interest of consumer as well.