The use of microwave to inactivate enzymes in rape seeds

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Abstract

The high content of unsaturated fatty acids and enzymes can lead to low quality of rapeseeds during storage. The aim of this research was to investigate the effects of different microwave treatments to reduce the activity of selected enzymes in rape seeds (*Brassica napus L.*), and to compare those effects with that of conventional heating treatment. Treatment parameters were temperature, time and the continuity of microwave energy. The activities of the enzymes (methyllumbelliferyl-palmitic-acid-ester-hydrolase/MUPase and peroxidase) before and after treatment were analyzed.

The result showed that temperature effect was more dominant than time effect in reducing enzyme activities. For both microwave and conventional treatments, the activity of MUPase was highly reduced at temperatures above 70℃. Peroxidase was more resistant to high temperature than MUPase, and only microwave treatments (above 80℃) showed a strong reduction of peroxidase activity.

It can be concluded, that microwave treatment reduced enzymatic activities in rape seeds in shorter time than conventional heating methods. This was also noted for heat resistant enzyme.

Introduction

Oil seeds with high content of unsaturated lipids can easily be spoilt and become rancid. Most of these reactions are catalyzed through lipolytic enzymes. One of this group are lipid esterases, which split ester bonds in lipids (Franzke, 1981), increasing rapidly the amount of free fatty acid in the product (Carlson et al., 1981). Tao et al. (1993) noticed lipase inactivation in rice bran after microwave treatment determined through free fatty acid content. In this paper, the activity of such an enzyme was detected through an addition of 4-Methylumbelliferyl-palmitic-acid-ester (MUP) to an extract of plant product (Fretzdorff, 1994). The enzyme in extract, which splits MUP in its ester bonds is called methylumbelliferyl-palmitic-acid-ester-hydrolase or MUPase.

Peroxidase is another important enzyme in most plant products. It is heat stable (Baltes, 1992), and was used in this work as an indicator to the inactivation of other enzymes.

To reduce quality losses during storage, enzymes should be inactivated (Meister et al., 1994) For this purpose, either conventional or non-conventional heating methods (for example microwave) can be used. By the first method, heat energy penetrates in the material through radiation, conduction or convection, producing a temperature increase mostly on the surface which is higher than in deeper layers of the product, where most enzymes are located. On the other hand, some materials are capable of absorbing microwaves, resulting in temperature increase inside of the product at very short time. Temperature increase depends, more than by conventional heating methods, from the chemical composition of the treated materials (Fakhouri and Ramaswamy, 1993).

The aim of this research was to investigate the effects of different microwave treatments to reduce the activity of selected enzymes in rape seeds (Brassica napus L), and to compare those effects with that of conventional heating treatment.

Material and Method

The German 00 – rape was treated in laboratory microwave applicator (max. Power: 1200W, frequency: 2.45 GHz). The treatment parameters were temperature, time(Time 0 minutes means that the rape was treated until the desired temperature was reached. In microwave desired temperature was reached within 2 – 4 minutes, while in conventional oven within 55 – 85 minutes. Other time treatments mean that although the desired temperature was reached, the treatment continued until the duration time was reached) and the continuity of microwave energy. The activities of the enzymes (MUPase and peroxidase) in rape before and after microwave and conventional heating treatment were analyzed (Irfan et al., 1997).

Results

In general, MUPase was less resistant to the high

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temperature than peroxidase. This was noted both by microwave (Fig. 1 and 2) and by conventional heating treatment (Fig. 3). Almost all of MUPase in rape seeds was strongly inactivated with both treatments at temperatures above 70℃, while peroxidase was still active at this temperature.

The continuous microwave treatment reduced the activity of peroxidase better than the discontinuous one (Fig. 1), due probably to a faster temperature increase by proper treatment. This could explain why the effect of temperature in microwave treatments was more dominant than the effect of duration or time (Fig. 2).

During the early stages of heating time and the lower stages of heating temperature by using microwave, peroxidase was even first activated, and then was gradually destroyed at higher temperatures (Fig. 2b and 3). By conventional heating treatment, its activity was not destroyed, even at 90℃. At temperature above 80℃, microwave treatment showed much better results than conventional heating for reducing the activity of peroxidase (Fig. 3).

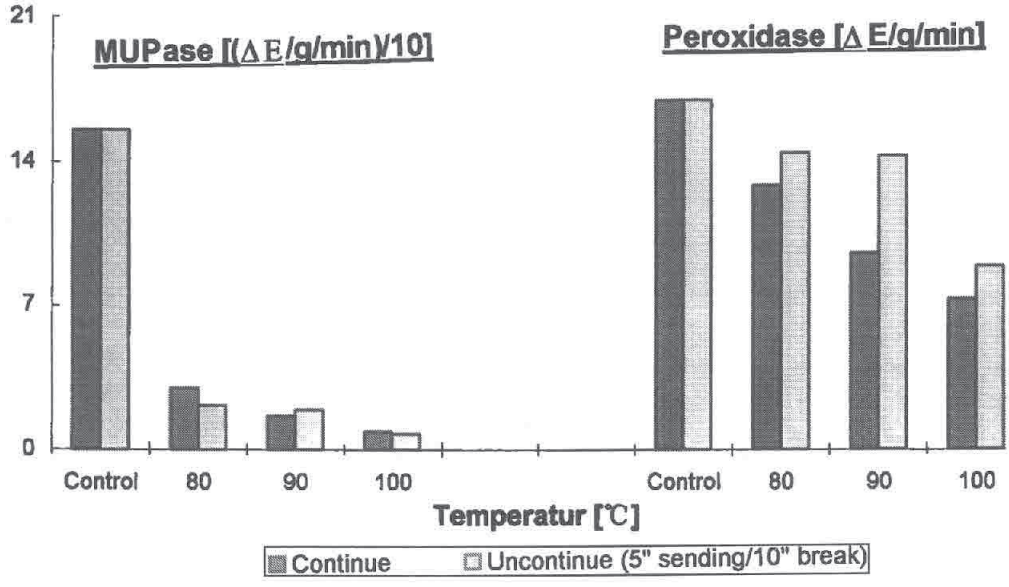

Fig. 1. The different continuity of microwave treatments and their effect on the enzymatic activities.

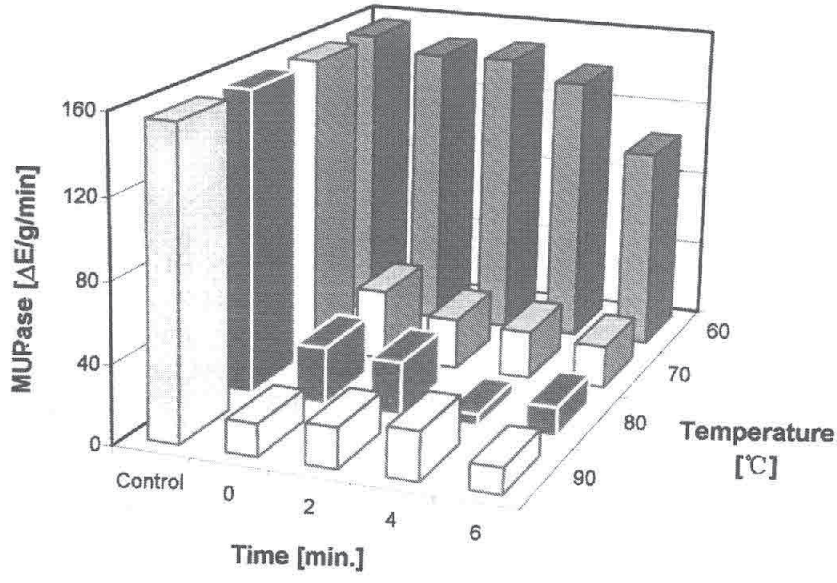

Fig. 2a. The effect of continuous microwave at different temperature and time on the enzymatic activities.

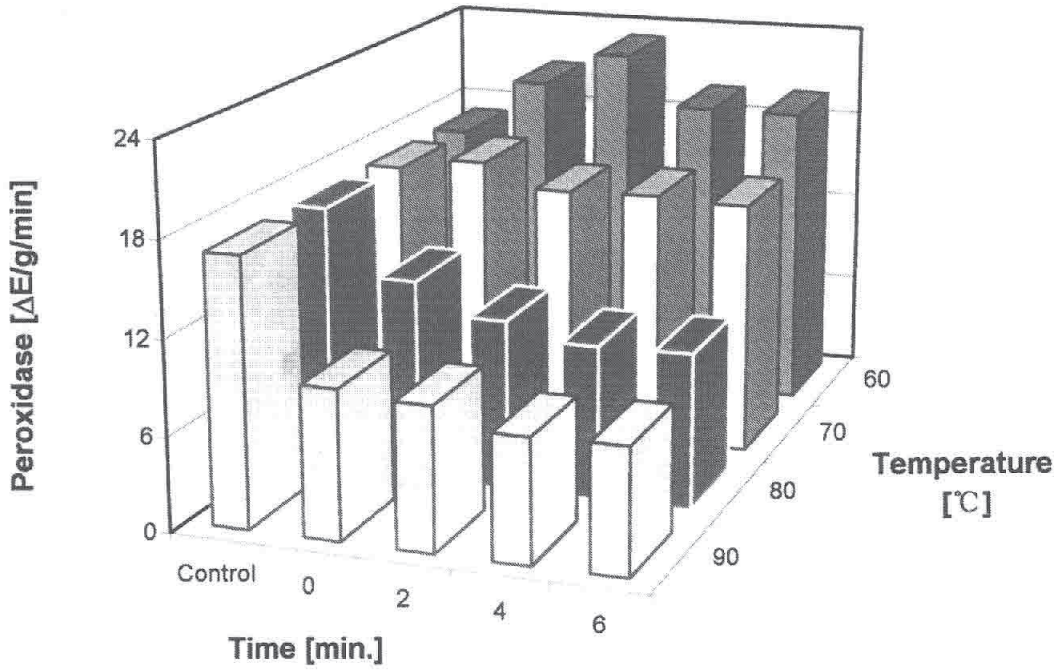

Fig. 2b. The effect of continue microwave at different temperature and time on the enzymatic activities.

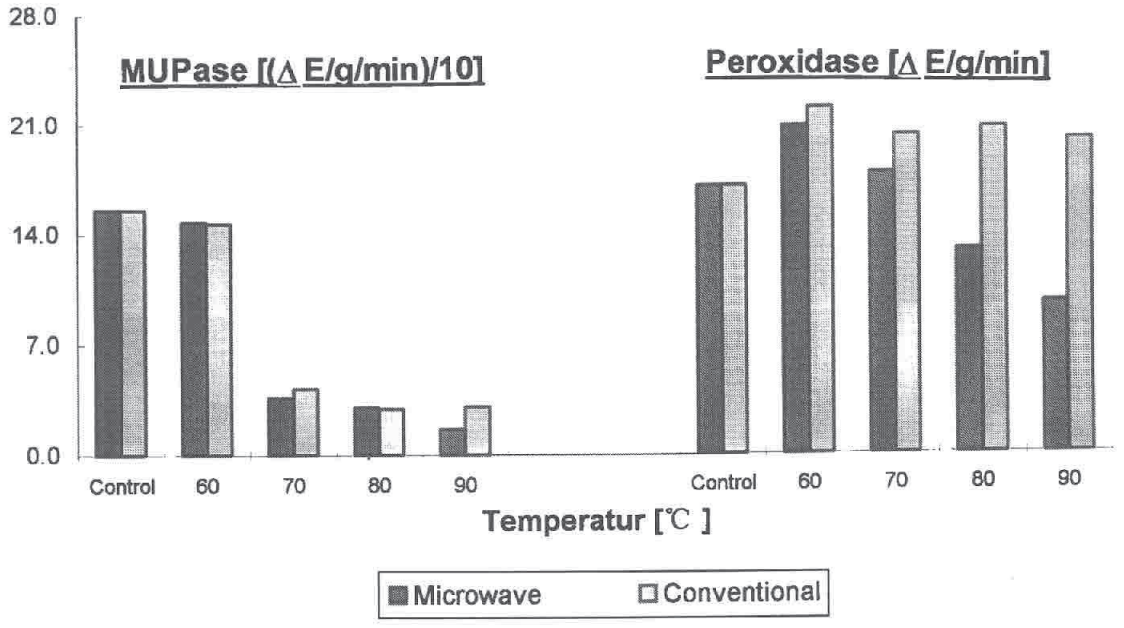

Fig. 3. Comparison between the effect of continuous microwave and conventional heating methods on enzymatic activities.

Conclusion

Microwave can be used to inactivate enzymes in rape seeds. Compared to conventional heating methods, the enzymatic activities were reduced in shorter time, and heat resistant enzymes like peroxidase can be inactivated at temperatures above 80℃. It is expected that microwave treated rape seeds are more stable for storage.

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