

THE USE OF LUPIN FOR MAKING TEMPE

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Tempe is a white mould cake which is traditionally prepared by fermenting soaked, dehulled, and cooked soybeans with a mould such as *Rhizopus Oligosporus* (Steinkraus et al. 1977). It has been produced in Indonesia for centuries. Tempe can be made from a range of other beans as raw material. Tempe from soybeans and from lupin seeds have a high nutritional value. The production of tempe involves two distinct fermentations (Steinkraus et al. 1977). The first occurs during the soaking and mostly involves bacteria such as *Bacillus cereus*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. *K. pneumoniae* is one of the bacteria which forms vitamin B₁₂. The second fermentation involves *Rhizopus* and opportunistic organisms. Fermentation improves the nutritional quality, digestibility and flavour of the bean, and also reduces cooking time (Reddy et al. 1982; Shama 1991).

Previous studies have found that the acceptability of lupin tempe by Australians is higher than soy tempe (Kidby et al. 1977); the appearance, flavour and nutritional quality are superior than soybean (Kyle et al. 1991), and lupin is a better substrate for mould growth than soy (Yu 1991). In the present study we investigated the acceptability of lupin tempe to Indonesians and Australians, the effect of tempe production on the protein quality, and the content of antinutritional factors in the raw material and the finished product.

In the sensory evaluation, the acceptability of lupin tempe (100%, 75%, 50%) was as high as for soy tempe with respect to appearance, taste and texture for Australians (n=14-22) and for Indonesians (n=5-8). The changes in content of antinutritional factors are shown in Table 1. In most cases the original low levels in the lupin seed kernels when compared to soybean kernels, were further lowered by the fermentation steps.

Table 1. The changes of antinutritional factors in kernels of lupin and soybean after cooking and fermentation (dry basis)

| | Lupinraw | Lupincooked | Lupintempe | Soy raw | Soycooked | Soytempe |
|----------------------------------|----------|-------------|------------|---------|-----------|----------|
| Alkaloid (total) (%) | 0.007 | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Trypsin inhibitor activity(mg/g) | 0.06 | 0.04 | 0.06 | 16.34 | 0.18 | 0.30 |
| Oligosaccharides | 6.07 | 0.66 | 0.87 | 5.71 | 1.45 | 1.30 |
| Phytate (%) | 0.62 | 0.48 | 0.25 | 1.05 | 1.09 | 0.87 |
| Free sugars (o/o) | 10.64 | 1.58 | 1.43 | 11.38 | 2.17 | 1.64 |
| Poyosaccharides (%) | 13.20 | 10.69 | 10.34 | 3.19 | 3.14 | 4.23 |

Other proximate data are shown in Table 2.

Table 2. Proximate analyses of lupin and soybean kernels before and after treatments (dry basis).

| | Lupin raw | Lupin cooked | Lupin tempe | Soy raw | Soy cooked | Soy tempe |
|-------------|-----------|--------------|-------------|---------|------------|-----------|
| Ash (%) | 2.55 | 1.35 | 1.52 | 4.89 | 2.67 | 2.87 |
| Fat (%) | 8.50 | 8.67 | 8.76 | 22.25 | 25.64 | 22.62 |
| Protein (%) | 42.57 | 44.61 | 44.65 | 45.48 | 52.78 | 53.82 |

The effects of fermentation on protein quality as measured by rat growth is being investigated. Results will be available in November 1992.

In conclusion, lupin can be substituted for soybean in tempe production. There would be advantages in term of price, appearance and in lower content of antinutritional factors. Some buyer resistance could arise if the traditional flavour of the soy is missing and it may prove necessary to blend the two 50% of lupin and soy. Studies are needed to determine whether vitamin B₁₂ is present and its level in lupin tempe.

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