THE INCLUSION OF LENTIL FLOUR IN BREAD

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ABSTRACT

Lentils are a good source of protein, carbohydrate, fibre, soluble fibre, and B vitamins. They contain low levels of fat, cholesterol and sodium - factors associated with cardiovascular disease. Lentils provide slowly absorbed carbohydrate which causes a flatter blood glucose profile even in non-insulin dependent *diabetes mellitus*. All of these factors make lentils a desirable addition to the New Zealand diet.

The main barrier to including lentils in our diet is finding an attractive way to present them. The inclusion of lentil flour in bread is one way to introduce lentils into the diet and this product was tested on a panel of consumers. It was found that although the lentil flour bread was easily distinguishable from plain flour bread, the former was quite acceptable to the panel.

Additional Key Words: *lentil flour, bread, fibre,* diabetes mellitus, *acceptability, colorimetry.*

INTRODUCTION

Lentils are a good source of easily available, cheap protein which can complement cereal protein for several essential amino acids (Savage, 1988). They have a considerable part to play in combating the protein-calorie deficiency conditions which occur in some countries. In many of the developing countries lentils are consumed as dahl mixed with other foods.

Lentils, apart from being a good source of protein, contain useful amounts of fibre, soluble fibre, potassium and B vitamins. They contain low levels of fat, cholesterol and sodium. These factors appear to protect cardiovascular health. Lentils provide slowly absorbed carbohydrate which gives a flatter blood glucose profile even in non-insulin dependent *diabetes mellitus* (Thorburn *et al.*, 1986). This 'slow release' property of lentils is heat labile which suggests that antinutrients or enzyme inhibitors are inducing this effect. Similar studies by Anderson & Ward (1979), Simpson *et al.* (1981) and Jenkins *et al.* (1984) have also shown the value of increased lentil or legume content in the diet of certain diabetic patients owing to the reduced rate of carbohydrate digestion. These features of lentils make them a desirable adjunct in human diets as they may provide a protective factor against the early onset of lifestyle diseases common in New Zealand and in other developed countries.

Jenkins *et al.* (1980) suggest that a change of diet to include higher proportions of lentils (partially replacing meat) would allow a higher carbohydrate diet to be eaten with a reduction in fat intake. Such changes would give lower fasting serum cholesterol concentrations and post-prandial blood glucose values. These changes may help reduce morbidity and mortality both from diabetes and arterial disease, towards levels seen in countries where more slow- release carbohydrates are eaten.

The main problem with the inclusion of lentils in New Zealand diets is to find an attractive way of presenting them. Some interesting cook books have been compiled and a New Zealand booklet containing a wide range of lentil dishes has recently been published (Hills *et al.*, 1983). The use of lentils in western diets is undoubtedly restricted by the time needed to process them (both soaking and cooking). One way to encourage their increased usage is to present them in a fully processed form much in the way navy beans are cooked, mixed with tomato sauce and canned to provide baked beans. Baked beans only need to be reheated to quickly provide a nutritious meal.

The inclusion of lentil flour in bread would increase the protein content and provide a useful method of including lentils in the diet of people requiring it for nutritional reasons. The inclusion of lentil flour in bread would also provide a non-obvious method of increasing lentil consumption in the diet. In addition it would provide bakers with another speciality product which may increase overall consumption of bread.

The use of composite flour in bread making has received some attention in the past few years. The addition of legume flours (e.g., soya bean) improves the nutritional value of bread not only because of its higher protein content but also because of its higher lysine content compared with wheat flour. D'Appolonia (1977) showed that flour prepared from a range of legumes including lentils could be successfully incorporated into bread. Indeed, bread containing 5 to 10 % legume flour showed a whiter crumb colour when compared with the whole-wheat loaf. D'Appolonia (1977) suggested that a lipoxygenase enzyme in the legume flour was responsible for the improved effect on crumb colour. This is interesting as lentil flours have a yellow or brown appearance. The addition of 10 % lentil resulted in a bread that had a pleasant taste and aroma appreciated by 67 % of the test panel (D'Appolonia, 1977).

The object of this experiment was to investigate the inclusion of finely ground lentil flour in traditionally baked wheat flour bread. It was proposed to investigate whether the inclusion of up to 10 % lentil flour in bread was acceptable according to a number of organoleptic measurements.

METHODS

Two types of bread were baked using a basic bread recipe (Browne *et al.*, 1981). New Zealand grown dried red lentils (cultivar Titore) were finely ground in an electric coffee mill and used in place of 10 % of the standard white flour in the basic bread recipe. Each sample of dough was processed and baked in the same way. Two 500 g loaves were made for both the white and lentil flour bread.

Proximate analysis: Moisture, ash, crude fibre and protein content was determined by standard AOAC Methods (1980).

Acceptability experiment: On the day of the experiment each sample of bread was cut into 10 mm slices and then cut into 30 x 30 mm squares. Three samples (labelled A, B or C) were placed on a paper plate and were accompanied by a questionnaire. Two of the samples were the plain white bread while the third sample was the lentil bread. Thirty eight participants of the legume conference were invited to taste each sample of bread in this triangle test and fill in their observations on the questionnaire. This triangle test evaluation was carried out in the same well lit room; none of the participants were aware which of the samples was the lentil bread. None of the participants had eaten or drunk anything for 3 hours before the evaluations. The participants were asked to score the attributes (Table 2) of each bread sample using a score from 1 to 5 according to the following: for the attributes appearance, aroma, colour, texture, flavour the score was from 1 (like) to 5 (dislike); for sweetness the score was 1 (not sweet) to 5 (very sweet); for saltiness the score was 1 (no salt) to 5 (too much salt); and for palate the score was 1 (bland) to 5 (bitter).

Colorimetry: Colorimetry was carried out on a Hunterlab Labscan spectrocolorimeter LS 5000 (Hunterlab Associates Laboratory Inc. Reston, Virginia, USA.) using illuminant D65 (Yn=100, Xn=94.83, Zn=107.38, Ka=172.1 Kb=66.7) 10 degree illumination standard observer through a 3 cm illumination port. Tristimulus XYZ, Lab and CIE (1976) $L^*a^*b^*$ values were measured such that, lightness $L^* = 116(Y/Yn)^{1/3} - 16$, red-green chromaticness $a^* = 500[(X/Xn)^{1/3} - (Y/Yn)^{1/3}]$, yellow-blue chromaticness $b^* = 200[(Y/Yn)^{1/3} - (Z/Zn)^{1/3}]$. The colorimeter was calibrated against a white tile (White LS-12118) which gave the following values: X 81.01, Y 86.69, Z 87.96.

Colorimetric measurements were made on freshly cut portions of each sample of bread. Four readings were taken of each sample (Table 4) with the sample being rotated through 90 ° after each reading.

Statistical analysis: The forms were coded and the attribute scores analysed using analysis of variance for a two factor design, the factors being subjects, and flour types.

RESULTS

The proximate composition of the two samples of bread was very similar (Table 1) except that the protein content of the lentil bread was 7 % higher than the plain flour bread. This resulted from the substitution of the higher protein lentils for wheat flour in the lentil bread.

A preliminary review of the anonymous comments on the forms suggested that the lentil bread was well liked. Mean data of the attributes evaluated for each bread sample are summarised in Table 2. Analysis of variance for each attribute shows that only for sweet taste was there any significant difference between the two breads ($P < 0.01$). Lentil bread was thought to be less sweet than plain flour bread. Figure 1 shows a profile of the mean attribute score for each bread for each of the parameters the tasters were asked to evaluate.

Table 1. Proximate composition of each bread

(g/100 as consumed)	Plain Flour	Lentil Flour
Moisture	46.71	45.07
Ash	1.25	1.29
Protein	7.40	7.91
Fat	0.37	0.54
Crude Fibre	0.34	0.34

Table 2. Mean values for the attribute scores for each bread.

Attribute	Plain flour	Lentil flour	SED
Appearance	2.53	2.81	0.19
Aroma	2.42	2.72	0.17
Colour	2.50	2.45	0.17
Texture	2.47	2.78	0.20
Flavour	2.54	2.43	0.17
Sweetness	3.26	3.61	0.13**
Saltiness	2.51	2.44	0.11
Palate	2.24	2.44	0.13

** Significant $P < 0.01$

Table 3 shows that equal numbers of observers preferred the plain flour and lentil breads. Twenty two (58 %) of the 38 participants correctly identified the lentil bread while 10 were unable to make a choice and 6 made an incorrect choice.

The lentil bread appeared to have an orange cast which resulted from the inclusion of lentil flour prepared from cultivar Titore which has a distinctive orange/red hue. The colorimeter could detect significant differences between the colour of the two samples of breads (Table 4) but this difference in colour was not disliked by the tasters (Table 2).

Table 3. Preferences for each sample and detectability of lentil flour

	Preferences	Detection
Plain bread (sample 1)	11	2
Plain bread (sample 2)	6	4
Lentil bread (sample 3)	16	22
No answer	5	10

CONCLUSIONS

From this experiment it is clear that bread made from flour supplemented with finely ground lentil can easily be detected. However, given that people can identify the bread there does not seem to be any aversion to it, and preferences seem to be evenly divided between plain flour and lentil flour bread.

Bread made from lentil flour had a reasonably distinctive orange cast derived from the lentil cultivar Titore. This result is in contrast to the observations of D'Appolonia (1977) who stated that bread baked with 5 or 10 % lentil flour showed a whiter crumb colour compared to the control loaf. D'Appolonia observed that the original lentil flour in his experiment had a yellow colour which suggests that cultivar Laird might have been used in his experiments. Laird is a Canadian lentil cultivar and is widely grown in that country.

Up to 10 % finely ground lentil flour can be added to wheat flour to make a nutritious and interesting loaf. The lentil flour loaf had a distinctive and interesting colour and a taste that was widely appreciated. The results from this preliminary experiment suggest that speciality loaves containing lentil flour may be of some interest to the consumer. The use of lentil containing bread would therefore increase the amount of legumes consumed in the diet without making any major changes to eating habits.

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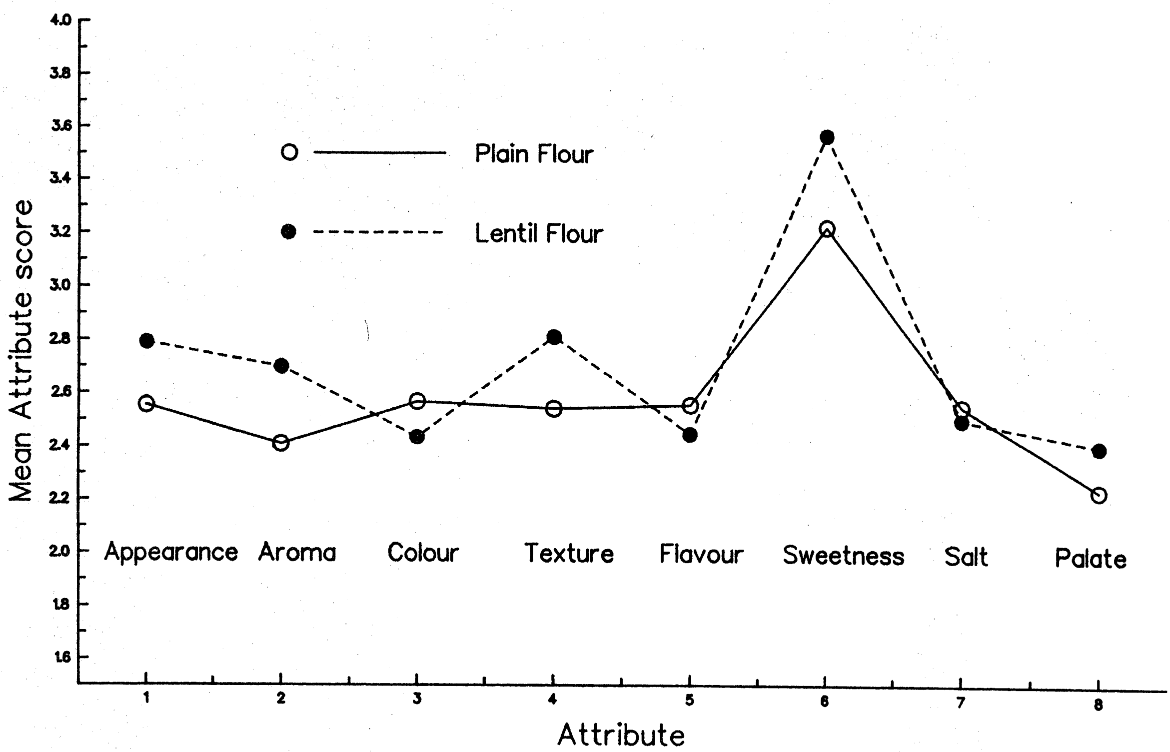

Figure 1. **Attribute profile of plain and lentil bread.**

Table 4. **Mean values and standard deviation for colorimetric measurements of each sample of bread**

Method of colour Determination		White bread Mean	White bread S.D.	Lentil bread Mean	Lentil bread S.D.	Significance (P)
Tristimulus	X	44.04	0.63	37.85	0.67	< 0.001
	Y	46.74	1.29	39.58	0.68	< 0.001
	Z	33.06	0.44	26.33	0.35	< 0.001
Lab	L	68.36	0.93	62.92	0.55	< 0.001
	a	0.62	0.28	0.94	0.07	N.S.
	b	15.55	0.78	15.95	0.24	N.S.
CIE	L^*	74.01	0.82	69.17	0.50	< 0.001
	a^*	0.69	0.30	1.05	0.07	N.S.
	b^*	20.15	1.04	21.64	0.30	N.S.

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