

Fortification of Chappati with Added Vitamin A

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Introduction

Many of the world's population suffer from the effects of vitamin A dietary deficiency. It is a major nutritional problem in Bangladesh. The Blindness Prevention Programme, in operation in Bangladesh since 1973, has estimated that at least 17,000 children aged 0-6 years go blind every year from Xerophthalmia¹. The 1975-76 nutrition survey of Bangladesh showed that 82% of households had vitamin A intake less than 50% of Recommended Dietary Allowance². The vitamin A in Bangladeshi diet mostly comes from vegetables as carotenoids which loss to some extent due to storage and cooking practices³.

Fortification of foods with vitamins, minerals, amino acids has been practised extensively in different parts of the world for a long time. Bauernfeind and Cort⁴ and Borenstein⁵ have reviewed the addition of synthetic vitamin A to many foods such as salad oils, margarine, groundnut butter, liquid skin milk, nonfat dry milk, ice cream, butter cheese, white flour, bread, cakes, cookies, white rice, potato chips, fruit juice beverages and powders, confectionaries, tea dust and refined crystalline sugar.

The purpose of this study was to fortify wheat flour with pre-mix vitamin A and to observe the retention of added vitamin A in different stages of preparation, heating and storage of chappaties.

Materials and Methods

Fortification of wheat flour: Pre-mix wheat with vitamin A was collected from HKI, Dhaka. Exactly 37.5 g pre-mix wheat was added to 15 kg wheat, mixed in a mechanical mixture machine and then grinded in a chakki mill. Similarly another portion of pre-mix wheat was added to wheat, mixed in a mechanical mixture machine and grinded in a coffee grinder. The temperature of the flour coming from chakki mill and in the coffee grinder were 35-55°C and 32-43°C, respectively. These samples are termed as fortified wheat flour grinded in chakki mill and coffee grinder, respectively.

Chappati preparation: Fifteen chappaties were made from 750g of fortified wheat flour according to the usual method of chappati preparation in our country. The weight of chappati varied from 80 to 85g before baking and 70 to 75g after baking. The diameter of chappati varied from 18 to 19.5 cm. The fry pan is made of iron sheet. The temperature of chappati just after baking was 90 to 100°C. This chappati is termed as wet chappati. The time of each chappati baking was 1.1 to 1.2 minutes. Eight chappaties were grinded in a waring blender, dried in a air circulating oven for one hour at 48 to 49°C, and used for the analysis of moisture and vitamin A contents. This sample is termed as dried chappati. Some chappaties were placed in ploythene bags and kept at room

temperature (22-35⁰C) for 7 days in dark. The samples were then analysed for moisture and vitamin A contents.

Methods: Moisture content of different samples was determined by drying the samples in an oven at 105⁰C until constant weight was found. For the determination of vitamin A, each sample was saponified, extracted and finally injected into HPLC according to the method of Landers and Olson⁶. All steps were performed under reduced light. About 10g sample was refluxed in 60 ml of 100% ethanol containing 12 ml of a 47% aqueous potassium hydroxide solution for 30 minutes at 80⁰C. After cooling, the reflux mixture was extracted with 75 ml hexane 3 times. The hexane extracts were combined and made a final volume of 250 ml. Vitamin A content of samples was measured by injecting 10 µl of hexane extract into the HPLC system. The following conditions were used: A 250 X 4.6 mm Lichrospher Si 1000 10µ column with a mobile phase of hexane/ ethylacetate/ dioxane (86:12:2) was used to separate the 13- Cis isomer from all-trans retinol. The eluting peaks were detected at 325 nm in a variable wavelength detector. The flow rate used was 1.0 ml/minute. Standard of all-trans retinol was

used to calibrate the system. Peak areas were integrated and correlated with concentration of standard.

Results

Moisture and vitamin A contents of fresh samples at different stages are shown in Table-1. The fortified wheat flour grinded in coffee grinder contained 12% moisture whereas those grinded in chakki mill contained 11% moisture. After drying at 48 to 49⁰C for one hour there was still 10% moisture in chappati. The pre-mix sample contained 4506 IU vitamin A/g. When moisture was corrected this value became 5004 IU. The fortified wheat flour grinded in chakki mill contained less vitamin A than that of grinded in coffee grinder. After moisture correction it was found that the dried chappati lost some of its vitamin content as compared to wet chappati (11.31 IU¹ VS. 11.57 IU vitamin A per g sample).

After 7 days storage, the moisture and vitamin A contents of fortified wheat flour grinded in chakki mill were found 12g/100g and 10.65 IU/g sample, respectively (Table II). The vitamin A values were found 12.02, 11.13 and 11.23 IU/g moisture corrected sample for fortified wheat flour grinded in chakki mill, wet chappati and dried chappati, respectively.

Table 1. *Moisture and Vitamin A Contents of Fresh Samples*

Parameters	Pre- mix ¹	Fortified wheat flour grinded in coffee grinder	Fortified wheat flour grinded in chakki mill	Chappati (wet)	Chappati (dried in oven) ²
Moisture, g/100g	10.0±0.011(3) ³	12.0±0.013(3)	11.0±0.013(3)	30.0±0.12(3)	10.0±0.011(3)
Vitamin A, IU/g					
Normal	4506±299(6)	12.64±0.56 (4)	11.79±0.39(4)	8.15±0.04(4)	10.15±0.45 (4)
Moisture Corrected	5004± 332(6)	14.29± 0.66 (4)	13.29± 0.44(4)	11.57±0.06(4)	11.31±0.49(4)

¹The vitamin product mixed with a carrier to be added to food, particularly in dry form, is referred as a pre-mix.

²Dried at 48 to 49⁰C for 1 hour.

³Mean ± S.D. In parenthesis number of observations.

Table 2. *Moisture and Vitamin A Contents of Samples after 7 Days Storage*

Parameters	Fortified wheat flour grinded in chakki mill	Chappati (wet)	Chappati (dried in oven) ¹
Moisture, g/100g	12.0 ± 0.012 (3) ²	30.0 ± 0.011 (3)	10.0 ± 0.012(3)
Vitamin A, IU/g			
Normal	10.65 ± 0.04 (4)	7.95 ± 0.49 (2)	10.13 ± 0.17 (2)
Moisture corrected	10.02 ± 0.50 (4)	11.13 ± 0.47 (2)	11.23 ± 0.18 (2)

¹Dried at 48 to 49°C for 1 hour.

²Mean ± S D. In parenthesis number of observations.

Table 3. *Retention of Added Vitamin A in Different Stages.*

Condition	Percent retention
Fortified wheat flour grinded in chakki mill vs. coffee grinder	93.0
Retention of vitamin A when chappati prepared from fortified wheat flour grinded in chakki mill	87.1
Fresh chappati (dry vs. wet)	97.7
After 7 days, fortified wheat flour grinded in chakki mill	90.4
After 7 days, old wet chappati vs. fresh wet chappati	96.2
After 7 days, old dry chappati vs. fresh dry chappati.	99.3

Percent retention of added vitamin A in different stages is shown in Table III. The retention of vitamin A was 93% when fortified wheat flour was grinded in chakki mill as compared to that grinded in coffee grinder. There was 87.1% retention of vitamin A when chappati was prepared from fortified wheat flour. When fresh chappati dried there was 97.7% vitamin A retention than that in the wet chappati. After 7 days the fortified wheat flour grinded in chakki mill contained 90.4% of its original added vitamin A. Similarly, old wet and dry chappati retained 96.2 and 99.3% of its original vitamin A present in fresh wet and dry chappati, respectively.

Discussion

Nutrient fortification or enrichment is attractive as a major weapon in the war against malnutrition because it provided a simple way of increasing the nutrient content of foods. A variety of foods can be used as carriers for additional nutrients. Berg and Levinson^{7,8} have written extensively on the characteristics of carriers and on problems in the implementation of fortification programmes. Widespread vitamin A deficiencies in the population of developing countries have resulted in an exploration of ways to increase the daily vitamin A intake. In recent years the

development of stable dry forms of vitamin A of a variable range of particle size have greatly broadened the scope of foods amenable to vitamin A fortification and it is now possible to fortify a number of products such as wheat flour⁹. The need for fortification of cereal grain products with vitamin A was first suggested to the vitamin industry by UNICEF personnel. In December 1967, fortification of white bread with vitamin A, water-soluble vitamins, and iron was instituted in a new-government-owned bakery in Bombay⁴. In our present study, we have taken an attempt to fortify wheat flour with pre-mix vitamin A wheat. We found 7% loss of vitamin A when fortified wheat flour was grinded in chakki mill as compared to that grinded in coffee grinder. This may be due to higher temperature in chakki mill which destroy some of the vitamin A present in fortified wheat. Bauernfeind and Cort⁴ pointed out that higher temperature may destroy vitamin A. So potential stress should be given during milling of whole wheat and also during drying of chappati. We found 2.3% further loss of vitamin A when fresh chappati was dried in a fry pan. Fortified wheat flour grinded in chakki mill retained 90.4% vitamin A after 7 days storage at room temperature. Bauernfeind and Cort⁴ reported similar type of findings. Vitamin A fortified wheat flour of moisture 13.5% and 13.8% has shown a stability of 86% retention after 6 months at room temperature. In flour of 11% moisture typical retention was 90% after 6 months at room temperature¹⁰. Furthermore, when fortified wheat flour was baked in chappatis, bread and tortillas, vitamin A retention values between 87 and 95 percent have been recorded. In our study, we found 87.1% retention during this process.

It seems that the loss of vitamin A in fortified wheat flour is minimal during

different stages of chappati preparation, heating and storage of chappati.

Summary

Pre-mix vitamin A wheat was added to whole wheat, grinded, and prepared chapatis. Moisture and vitamin A contents of samples at different stages were determined. Moisture content was observed 11, 30, 10g per 100 g sample in fortified wheat flour grinded in chakki mill, wet chappati, and chappati dried in oven at 48 to 49°C for 1 hour, respectively. The corresponding vitamin A values were 13.29, 11.57, 11.31 IU per g moisture corrected sample. It was also observed that 7% vitamin A was lost when fortified wheat was grinded in chakki mill as compared to that grinded in coffee grinder. After 7 days storage of samples, the vitamin A values were observed 12.02, 11.13, 11.23 IU per g moisture corrected fortified wheat flour, wet chappati, and chappati dried in oven, respectively. During drying of chappati in oven, there was 97.7% retention of vitamin A. Also old wet and dry chappati retained 96.2% and 99.3% vitamin A than that of present in fresh wet and dry chappati, respectively. It is concluded that there are some losses of vitamin A during grinding of fortified wheat, preparation and drying of chappati and also during storage of chappati, but the loss is minimum.

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