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COMMUNICATION (III)

Effect of Tertiarybutylhydroquinone on the stability of fried banana chips

RINGKASAN

Perbandingan kestabilan terhadap pengoksidanan ke atas kerepek pisang yang digoreng dalam minyak kelapa sawit olein yang mengandungi antioksidan, tertiarybutylhydroquinone, dan minyak kelapa sawit olein tanpa antioksidan telah dikaji. Nilai-nilai peroksid dan anisidin bagi minyak yang diekstrak dari kerepek yang disimpan pada suhu 60° C menjelaskan kerepek pisang yang digoreng dalam minyak mengandungi tertiarybutylhydroquinone memperolehi kestabilan yang lebih baik terhadap jangkamasa penyimpanan bagi kerepek tersebut.

INTRODUCTION

The stability of oil and fat-containing food is dependent to a large extent on the degree of oxidative deterioration of the oil in the product (Sherwin and Thompson, 1967; Konstance *et al.*, 1978). In addition, the quality of deep-fried snack foods and their shelf-life stability differs with the type of frying medium (Evans and Shaw, 1968; Robertson and Morrison, 1978) and the food used in the preparation of the product. Antioxidants have been added to frying media to improve the shelf-life of deep-fried snack food products (Stuckey, 1968). However, the choice of antioxidant depends on the type of fat used (Stuckey, 1968) because the effectiveness of an antioxidant in inhibiting the oxidative deterioration of the oil is different in different oils (Sherwin and Luckadoo, 1970). Despite the obvious importance of the stability of deep fried products upon storage, there has been limited work in this area (Robertson and Morrison, 1972; Fritsch *et al.*, 1975). In this study, the stability was compared for banana chips fried in refined, bleached and deodorised palm olein (RBD olein) with and without the antioxidant tertiarybutylhydroquinone (TBHQ). RBD olein was chosen as the frying medium because it is the major type of cooking oil used in Malaysia. The antioxidant, TBHQ, has been previously shown to be an effective antioxidant for RBD olein (Augustin and Berry, 1982). Bananas were used in view of the rapidly increasing popularity of banana chips as a Malaysian snack food.

The peroxide and anisidine values of the oil extracted from the banana chips were used as indicators of the stability of the banana chips. The peroxide and anisidine values are measures of the degree of primary and secondary oxidation of the oil respectively and they relate to organoleptic and flavour scores of oils (Frioriti *et al.*, 1974; Gray 1978).

MATERIALS AND METHODS

Refined, bleached and deodorized palm olein was obtained from a local refinery. It had been fractioned using the Lipofrac Process of fractionation on refined palm oil. The oil was used within one week of being fractionated.

The antioxidant tertiarybutylhydroquinone of analytical grade was obtained from Supelco Inc. Bellfonte, PA, USA. The bananas (*Musa paradisiaca*, Linn.), *pisang nangka* variety, were obtained from the local market. Slightly under-ripe bananas were used as this is the usual practice in the preparation of fried banana chips.

Addition of Antioxidant

TBHQ at a level of 200 ppm was added directly to RBD olein before the frying operation. The oil was stirred at 60° C for one hour to ensure complete dissolution of the antioxidant in the oil.

Preparation of Banana Chips

Banana rounds of 1.5 mm thickness were cut using a mechanical slicer. The banana rounds were soaked in 2% salt brine solution for 30 mins prior to frying.

The banana chips were fried in a stainless steel thermostated deep-fryer (Model Hamilton De Lux) containing RBD olein (5 kg) heated to 190° C. A batch of 3.0 kg of banana rounds were placed in the frying basket and the rounds were

fried for 10 mins. The temperature drop during frying was 10° C. The chips were allowed to drain for 20 sec, after which the chips were dabbed with tissue paper for 60 sec to remove excess oil. The chips were packed in 125 ml stoppered brown glass bottles and stored in a convection oven at 60° C for 5 weeks. The chips were removed from the oven for evaluation at weekly intervals. There were enough bottles stored so that a bottle of chips did not have to be reused once it had been removed from the oven. A batch of chips was also kept at room temperature (~25° C) for testing at the end of 5 weeks.

Physical and Chemical Analyses

The moisture and oil contents of the banana rounds and chips were determined according to AOAC 1975 Methods. Peroxide and iodine values of the oil were determined in accordance with the AOCS Official Methods (1974). The IUPAC Methods of (Paquot, 1979) were used for the determination of anisidine and acid values. All analyses were carried out in triplicate. The errors quoted are the mean errors in the analyses.

RESULTS AND DISCUSSION

Characteristics of Oil and Banana Chips

The RBD olein used for frying experiments had an acid value of 0.17 ± 0.03 and an iodine value of 58.3 ± 0.2. The peroxide and anisidine values of the fresh olein were 1.1 ± 0.1 meq/kg and 4.7 ± 0.2 respectively. After frying of the banana chips, the peroxide value of the used oil without antioxidants had increased to 4.6 ± 0.3 meq/kg while its anisidine value was 5.2 ± 0.2. The used oil with added TBHQ had peroxide and anisidine values of 2.0 ± 0.1 meq/kg and 2.9 ± 0.2 respectively. The banana chips had a moisture content of 2.5%. The oil content of the banana rounds before frying was 0.5% and rose to 17.5% in the deep-fried banana chips.

Evaluation of the Stability of Banana Chips

The peroxide and anisidine values of the oil extracted from banana chips fried in RBD olein increased steadily over the 5-week storage period. This showed that the quality of the banana chips deteriorated on storage at 60° C as expected. It was observed that the oil extracted from the chips fried in RBD olein containing TBHQ attained lower peroxide and anisidine values than that obtained from chips fried in RBD olein without antioxidants (Figures 1 and 2). The degree of oxidative deterioration of the oil extracted from the chips, as indicated by the peroxide and anisidine values, showed that the stability of banana chips was improved when RBD olein with added TBHQ was used as the frying medium. The oxidation state of the oil extracted from the chips may be attributed to an interplay of the carry-through effect of the antioxidant and the degree of oxidation of the oil absorbed by the chips. In this study it was noted that the oil extracted from chips immediately after frying had a lower state of oxidation when the chips were fried in RBD olein containing TBHQ (Peroxide value 2.0 ± 0.1 meq/kg, anisidine value 2.9 ± 1). The corresponding values for the peroxide and anisidine values of the oil extracted from chips fried in RBD olein without antioxidants were 4.7 ± 0.2 meq/kg, and 5.2 ± 0.2 respectively. The lower initial state of oxidation of the oil extracted from chips fried in oil containing TBHQ renders it less susceptible to further oxidative deterioration during storage. This is in agreement with the observation that the susceptibility of an oil to oxidative degradation is dependent, among other factors, on the initial oxidation state of the oil (Sherwin, 1978). It is therefore apparent that the role of TBHQ in improving the stability of the chips stems in part from its protective action on the oxidation of RBD olein during the deep-frying process. It has been suggested previously that an important use of an antioxidant in frying operations is to protect the fat from oxidation during the short period of exposure of the oil to the high temperatures used for frying (Stuckey, 1968). Evidence of this protective effect of the antioxidant during frying is

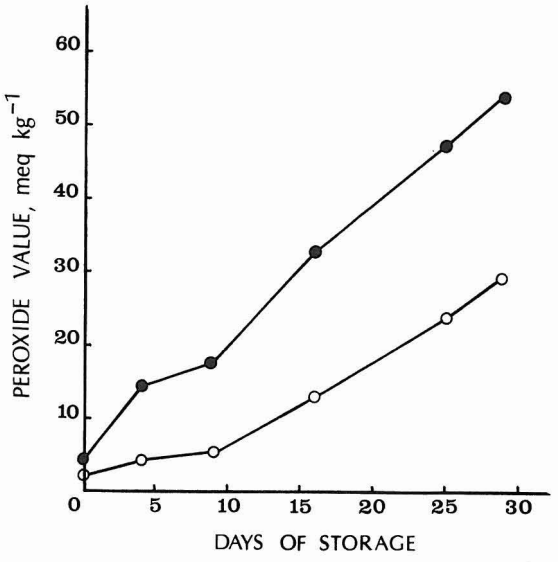

Fig. 1. Peroxide values of oil extracted from banana chips stored at 60° C; (Chips fried in RBD olein; ●-without anti-oxidants, ○-with 200 ppm TBHQ).

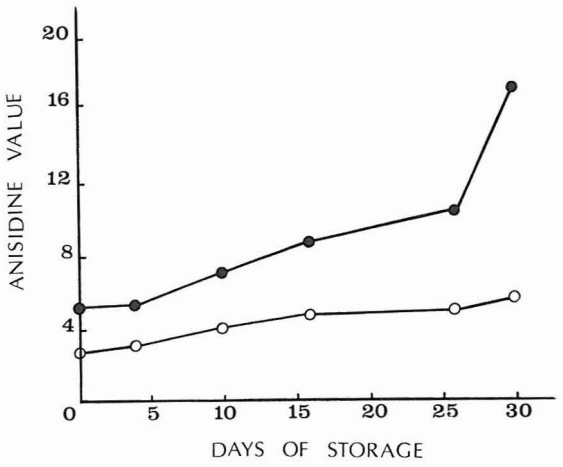

Fig. 2. Anisidine values of oil extracted from banana chips stored at 60° C; (Chips fried in RBD olein: ●-without antioxidants, ○- with 200 ppm TBHQ).

confirmed by the lower oxidation values of the used RBD olein containing TBHQ.

The role of the carry-through effect of an antioxidant in imparting improved stability to the banana chips cannot be disregarded. The degree of carry-through effect is related to the amount of antioxidant which has been transferred from the oil to the banana chips during frying. Although the concentration of antioxidant in the banana chips was not examined in this study, the observation that the protection afforded by TBHQ during storage was less in banana chips than in fresh RBD olein (Augustin and Berry, 1982) indicates that there is an incomplete carry-through of TBHQ during frying. In addition, it has been reported that under frying conditions phenolic antioxidants are destroyed (Luckadoo and Sherwin, 1972; Lin *et al.*, 1979).

Although the study was carried out under accelerated conditions (60° C), the validity of the results is supported by an evaluation of the chips stored at room temperature. At the end of 5 weeks storage at room temperature, the chips fried in RBD olein containing TBHQ (Peroxide value 2.6 ± 0.2 meq/kg, anisidine value 4.3 ± 0.2) also showed improved stability over chips fried in oil without antioxidants (Peroxide value 6.2 ± 0.2 meq/kg, anisidine value 7.7 ± 0.2). As expected, the state of oxidation of the oil extracted from the chips stored at room temperature was lower than that obtained from chips stored at 60° C for the same period.

This study has revealed that the shelf-life of deep-fried banana chips can be improved by the addition of the antioxidant TBHQ to RBD olein prior to the frying operation. It is to be noted, however, that TBHQ is not currently a permitted additive to foods in Malaysia, although its use for such purposes was approved in the United States in 1972. In the absence of legislative approval for TBHQ in Malaysia, it appears necessary to assess other permitted antioxidants and their effectiveness in improving the shelf-life of banana chips.

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