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# EFFECT OF MICROWAVE PASTEURISATION ON THE QUALITY OF FISH CHIKUWA

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## ABSTRACT

**Temperature profile of fish chikuwa was taken during microwave cooking at 100 power level for different durations and subjected to organoleptic evaluation. Moisture content and organoleptic quality of fish chikuwa paste mixed with different levels of moisture and cooked at 100 power levels for 6 minutes were analysed. Microwave cooked fish chikuwa with standardised recipe was heated in microwave oven with hot air at different temperature for different durations. Fish chikuwa microwave cooked at 100 power level for 6 minutes had higher scores for all attributes as compared to those cooked for different durations and also fulfill the condition of pasturisation of fish chikuwa. Fish chikuwa prepared with 35% moisture had better scores for all attributes unlike those of other levels. Heating of microwave pasteurized fish chikuwa at different temperatures for different durations could not achieve the desired brown colour.**

**Keywords : Fish chikuwa, pasteurization, microwave, moisture and browning**

## INTRODUCTION

Chikuwa is a Japanese fish paste product prepared by moulding the fish paste on wooden stick and broiled over charcoal fire till desired light brown colour is obtained on the surface of the chikuwa. Later improvement includes moulding on brass pipe and broiling over electric heat source or gas. These are ready to consume products, while prepared fresh and not stored (Suzuki, 1981). Use of microwave energy in food processing is gaining increasing popularity in institutions, commercial establishments and homes all over the world. It is due to its energy saving (40% efficiency as against 14% and 7% for electric and gas ovens respectively), nutrient saving, rapid, convenient and effective heating nature in food preparation and preservation. Besides, microwave cooking does not require additional water unlike conventional cooking and also provides clean cooking. Therefore, it was decided to prepare chikuwa by microwave cooking with convectional heating arrangement, which could achieve browning effect without charring and without the formation of polycyclic aromatic hydrocarbons and heterocyclic aromatic amines, which are formed during broiling over charcoal fire (Scharat & Cocoran, 1998; Gilbert, 2001).

## MATERIAL AND METHODS

Frozen surimi prepared from pink perch, *Nemipterus japonicus* containing food grade cryoprotectants such as sucrose 5% and 0.30% polyphosphate was procured from a commercial factory and stored in deep freezer at -14°C until further use. As and when required frozen surimi was taken out and thawed before use.

Fish paste was prepared with standard receipe as per Desai (1979) (Table 1A, Flowchart 1A), moulded into chikuwa shape having a diameter of 2.5 cm, cooked in microwave oven (BPL Sanyo, BMC 900T model with microwave frequency 2450 MHZ and KVT volume 36.8) for different durations, 5, 6, 7, 8, 9, 10 and 11 minutes, at 100 power level in the microwave oven and subjected to organoleptic evaluation by a group of ten trained panelists using a 10 point hedonic scale, *viz.,* excellent 10, very good 9, good 8, and very poor 1. The fish chikuwa was taken out from the microwave oven at the end of every duration mentioned above and temperature at the geometric centre of fish chikuwa was measure by piercing with a thermometer.

Fish paste was prepared as per the recipe (Table 1B), by adding ice water at different levels, *i.e.,* 10, 20, 30 35, 40 and 50%, respectively, to achieve different levels of moisture in the final product. The above fish paste was moulded into chikuwa shape and cooked into microwave oven at 100 power level for 6 minutes and subjected to organoleptic evaluation as above, and the moisture content of chikuwa before and after microwave cooking was analyzed as per AOAC (1975).

For browning effect fish chikuwa prepared with standardized recipe (Table 1C) and microwave pasteurized (100 power level for 6 minutes) was heated in the hot air (created by electric coil heating arrangement) in the microwave oven at temperature of 160, 170 and 180°C for different durations of 5, 7, 9 and 11 minutes, respectively and were subjected to organoleptic evaluation as above. Similarly, fish chikuwa was prepared as above; however, it was heated in the hot air first and then microwave pasteurised.

Wherever necessary, the experimental data were subjected to appropriate statistical analysis.

## RESULTS AND DISCUSSION

For elasticity formation of fish paste products it has been found that heating at 80 to 90°C is essential (Amano, 1995). Vegetative cells of most of the bacteria are killed in 5-10 minutes at 60 to 70°C while that of yeast and fungi are killed in 50 to 60°C (Pelczar *et al.,* 1988).

Microwave cooking of agriculture, fish and meat food products to an internal temperature of 70 to 80°C for 5 minutes was found to be sufficient for pasteurisation of the above products (Botta *et al.,* 1992; Huang *et al.,* 1993; Cole, 1995; and Park and Cliver, 1996).

Considering the above, microwave cooking to an internal temperature of 75°C for 5 minutes was chosen for pasteurisation in the present study.

The come up time to achieve a temperature of 75°C at the geometric centre

**Flowchart : 1A**

Frozen surimi

↓

Thawing

↓

Mixing with ingredients
(Salt, starch, ice water*)

↓

Mixing with 1% spice mixture
Shaping

↓

Microwave cooking at different power levels (100, 90 & 80)
for different durations 1, 2, 3, 4 minutes

**Flowchart : 1B**

Same as flow chart 1A except as follows:

↓

Microwave cooking at Hi 100 microwave power level setting for different durations 4, 5, 6, 7, 8, 9, 10 and 11 minutes

**Flowchart : 1C**

Standardized procedure for chikuwa preparation:-

↓

Same as flow chart 1A except as follows:

↓

Microwave cooking at 100 power level for 6 minutes

of fish chikuwa (Fig. 1) was found to be 1 minute, at 100 power level of the microwave oven as compared to 2 and 3 minutes for 90 and 80 power levels. Therefore, microwave cooking at 100 power level was chosen for further studies.

The purpose of pasteurisation microwave cooking of fish chikuwa at 100 power level for 6 minute (come up time 1 minute + 5 minute processing) would be sufficient. However, as microwave cooking is a new method of cooking to achieve proper cooking of fish chikuwa to be acceptable organoleptically, it was decided to cook the fish chikuwa at 100 power level for different durations.

The results (Fig. 1) indicated that chikuwa microwave cooked for 6 minutes had higher scores for all the attributes particularly for texture followed by those cooked for 5 minutes. Those cooked for 4 and 7 to 10 minutes scored low, *i.e.,* they were acceptable considering all the attributes. Those cooked for 11 minutes were between slightly poor and acceptable. It was noted by the panelists that those cooked for 4 minutes were slightly soft in texture and those cooked for 7 minutes and

**Table 1A : Receipe of fish chikuwa prepared with 1% spice mixure**

| INGREDIENTS | % | Composition of spices | |
|---|---|---|---|
| Fish meat | 100 | **Spices** | % |
| Salt | 2.0 | Pepper | 0.1 |
| Sugar | 1.5 | Laurel | 0.1 |
| Starch | 15 | Ginger | 0.1 |
| Ice water | 10 | Coriander Leaves | 0.3 |
| Spices | 1.0 | Chilly | 0.4 |

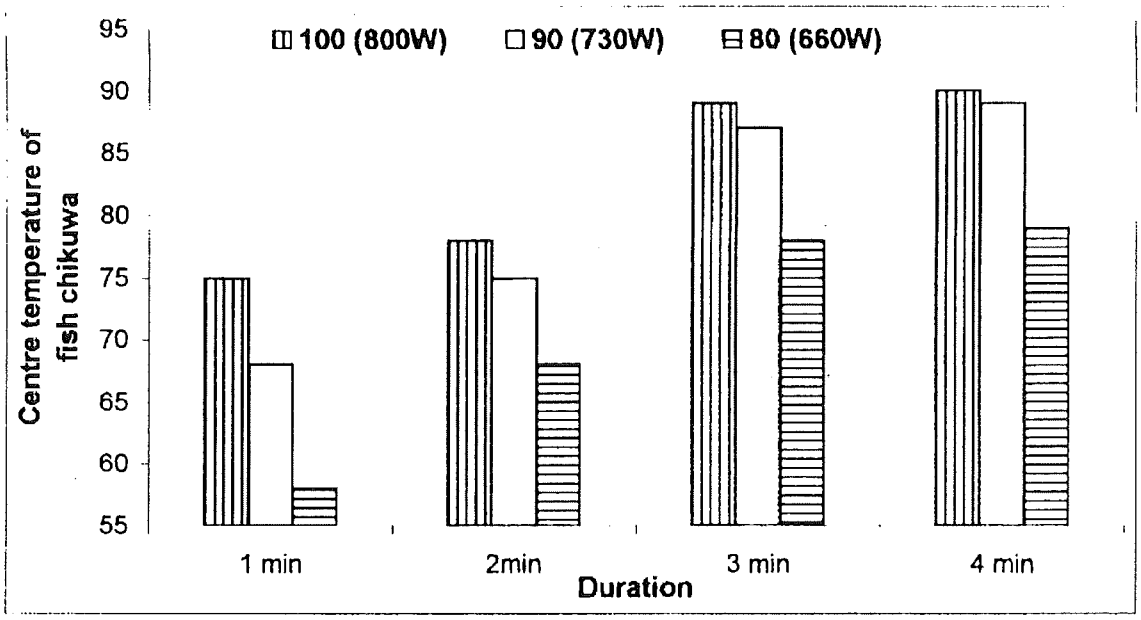


*Fig. 1 : Centre temperature of chikuwa during microwave cooking at different microwave power levels for different durations*

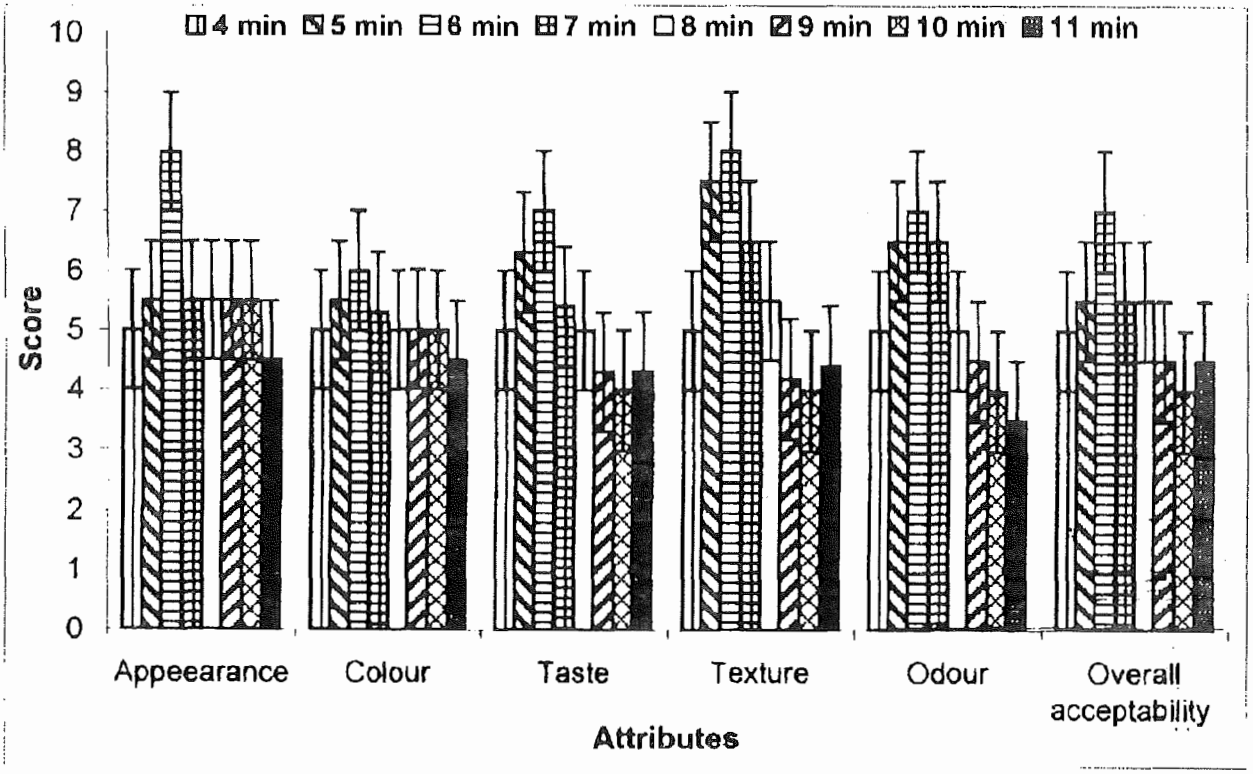


*Fig. 2 : Organoleptic evaluation of fish chikuwa cooked in microwave oven at 100 microwave power level for different durations*

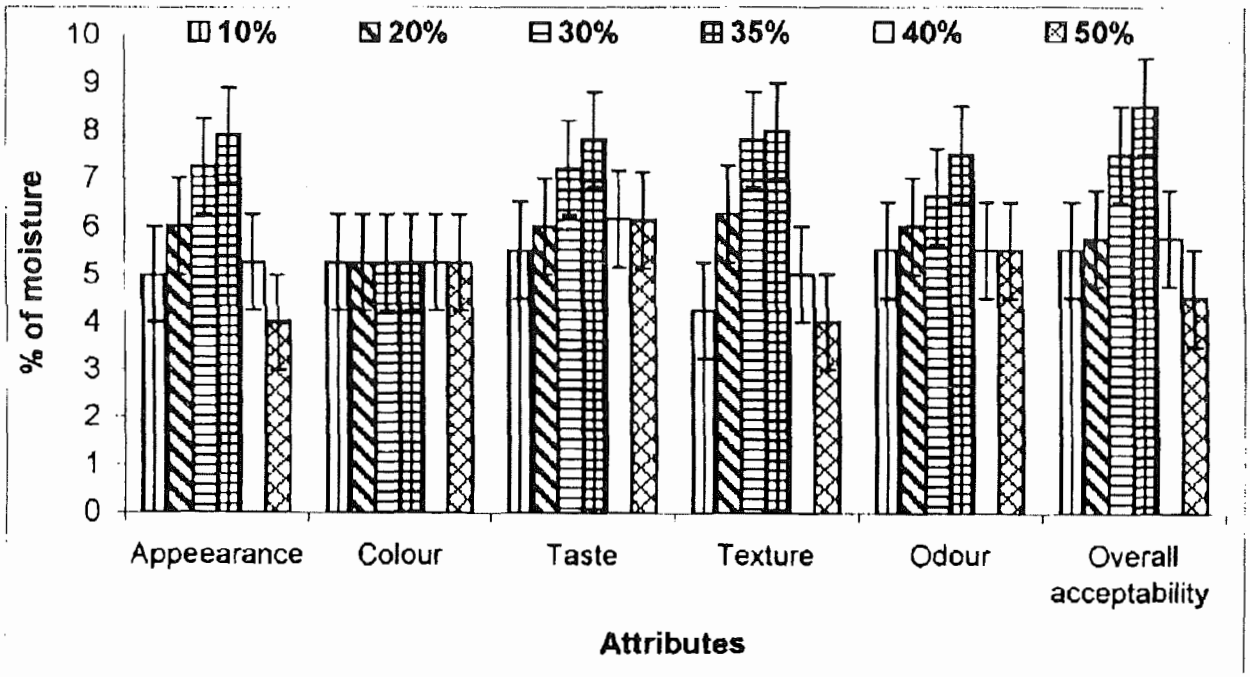


*Fig. 3 : The Organoleptic evaluation of fish chikuwa prepared with various levels of moisture*

above, the texture was severely affected, with hard and wood like appearance tending to appear in latter stages of microwave cooking. Hence, considering these defects, microwave cooking of chikuwa (2.5 cm in diameter) at a power level of 100 for 6 minutes was found adequate and fulfilled the conditions of pasteurization of chikuwa, *i.e.,* come up time of 1 minute to achieve centre temperature of 75°C and the holding period of 5 minutes at that temperature. The different treatments were found significantly different at $P < 0.05$ (ANOVA test) and chikuwa cooked in microwave oven at 100 microwave power level for 6 minutes was found to be superior to those of others (LSD test) as $P < 0.05$.

Botta *et al.,* 1992, observed that microwave cooking of frozen casserole of tuna fasta, celery and mushroom in cream sauce for 12 minutes (70-79°C) in microwave oven of 700 W capacity was sufficient to achieve pasteurisation and organoleptic quality was found to be good. The difference in the duration of cooking in their study and in the present study on fish chikuwa may be due to the change in the size of product and packing medium.

Although microwave cooking of fish chikuwa at 100 power level for 6 minutes was found to be suitable from both organoleptic as well as pasteurisation points of view, it was observed that on storage for 15 to 30 minutes, the product used to get dry, rubbery and salty in taste. It is possible that immediate consumption of fish chikuwa may not be possible and may require storage for some time before reheating to warm the product and consume. In the traditional method of fish chikuwa preparation, ice water is used at 10% level, and also to overcome the marginal difference between 6 and 7 minutes of microwave cooking with acceptable and unacceptable quality, respectively. It was found necessary to standardise the moisture level. However, to overcome the abovementioned defects, ice water was added to fish chikuwa at different levels.

As can be seen from the Fig. 3, among the chikuwa prepared with different moisture levels, the one with 35% moisture had better scores for all the attributes followed by 30 and 20% and those with 10 and 50% had the lowest scores. Chikuwa with 10% of moisture had rubbery texture with the difficulty of biting and mastication whereas with 50% became very soft and flabby. The different treatments were found significantly different at $P < 0.05$ (ANOVA test) and chikuwa prepared with 35% moisture level was found to be superior to others (LSD test at $P < 0.05$).

In terms of moisture loss (Fig. 4), fish chikuwa prepared with 10% moisture had higher loss (20.42%) as compared to those prepared with other moistue levels. Above organoleptic observations correlate with the moisture loss noted.

Although Olsen (1968) and Hwang *et al.* (1993) suggested use of plastic food wraps to insulate the food for preventing heat loss, it was not possible to get microwave packing material in India.

As microwave cooking cannot affect the development of brown colour on fish chikuwa, it was decided to try to develop the brown colour by heating in hot air (created by electric coil heating arrangement) in the same microwave oven.

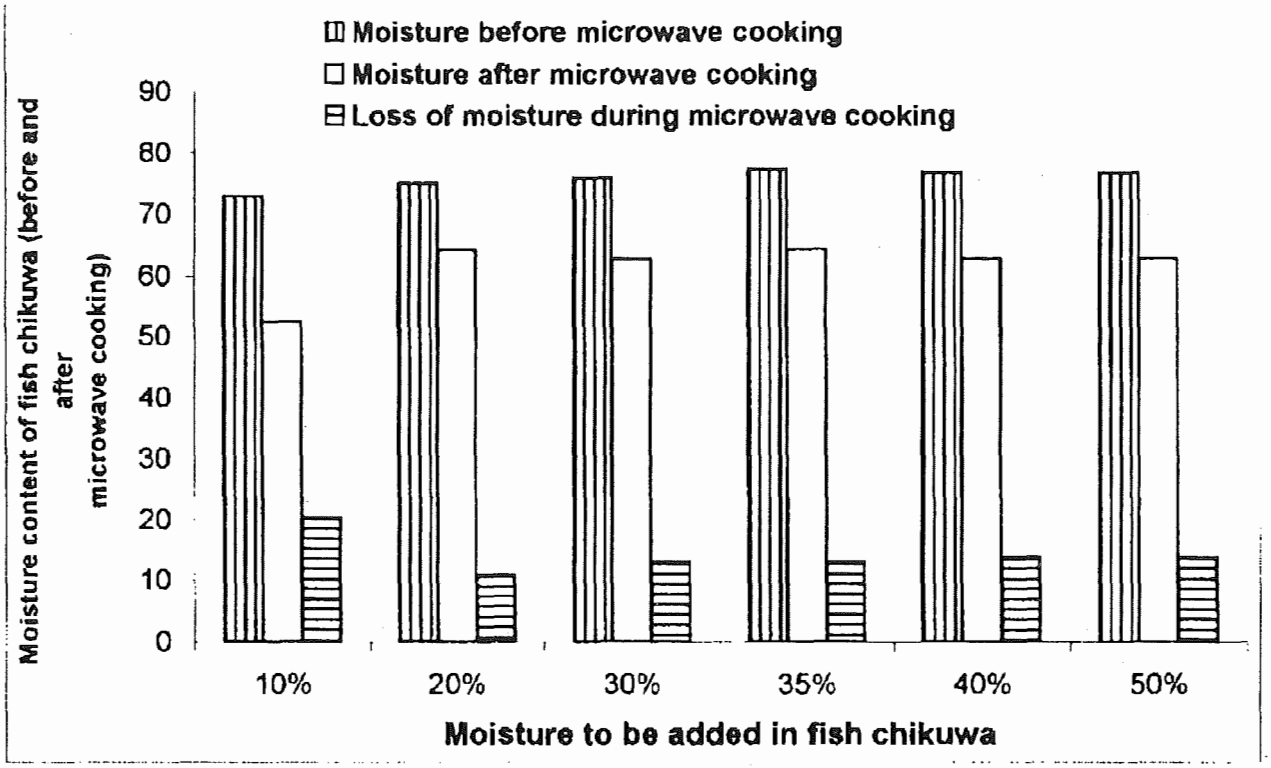


*Fig 4 : Changes in moisture content of fish chikuwa before and after microwave cooking*

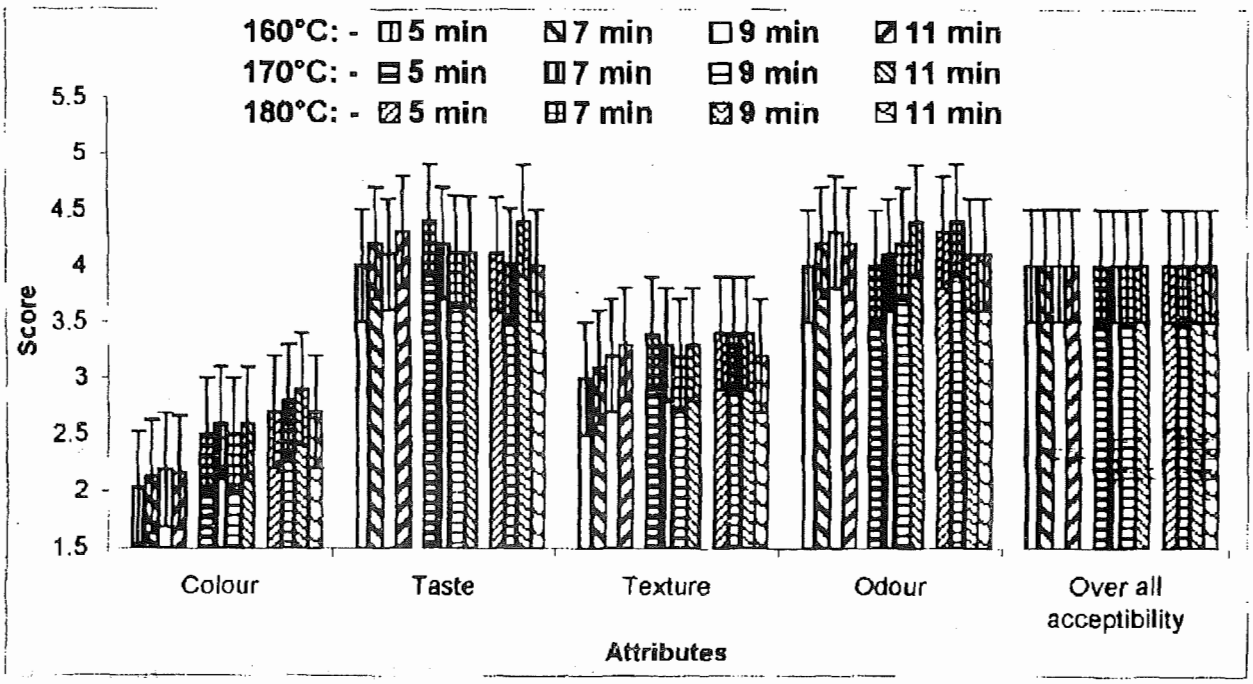


*Fig. 5 : Organoleptic evaluationof fish chikuwa heated by convectional heating at different temperatures for different durations (before microwave cooking)*

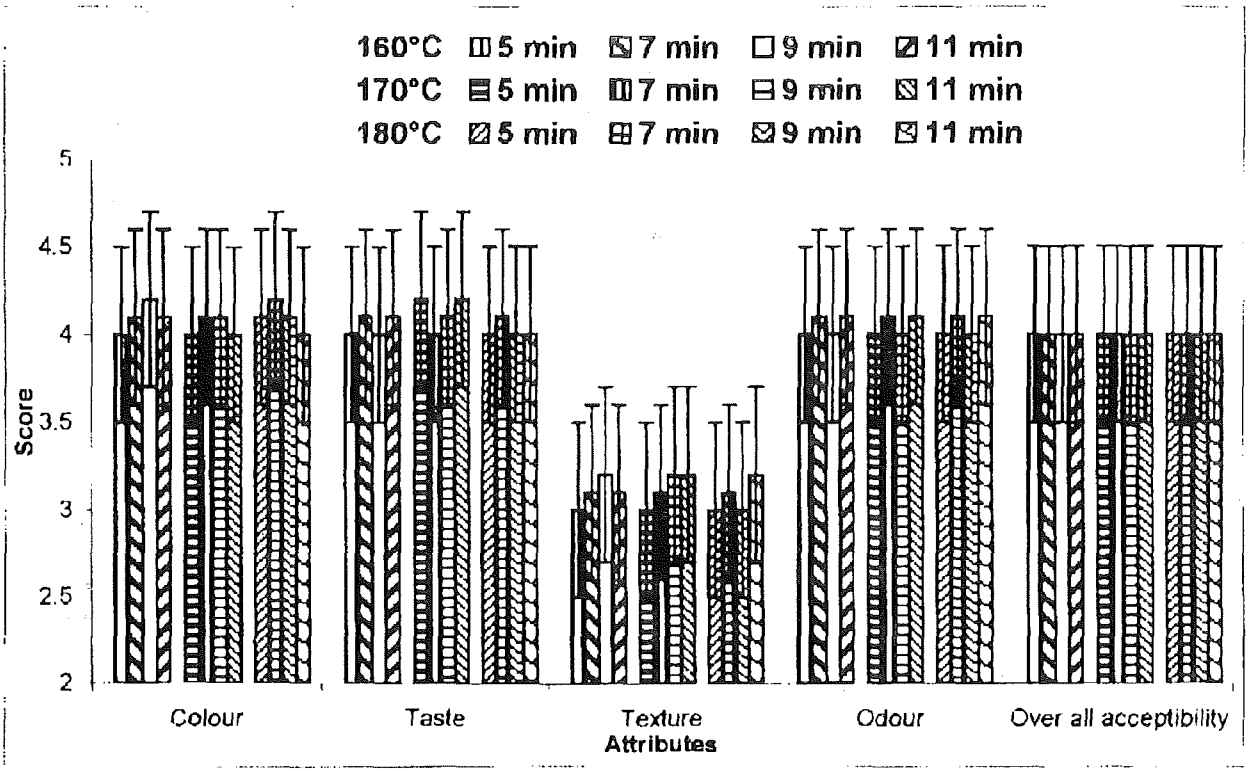


*Fig. 6 : Organoleptic evaluationof Fish chikuwa heated by convectional heating at different temperatures for different durations (after microwave cooking)*

Fig. 5 and 6 show the organoleptic evaluation of chikuwa heated at different temperatures (160, 170 and 180°C) for different durations (5 to 11 minutes) before and after microwave cooking. It was observed that heating in hot air at three different temperatures for different durations, either before or after microwave cooking, could not achieve the desired brown colour as compared with the traditional method of broiling.

Although it was aimed to develop microwave cooking of fish chikuwa, it was not possible to achieve desired brown colour of fish chikuwa traditionally obtained. However, during the course of study, the panelists suggested that the appearance of the product (long tube shaped) was aversive, the product was sliced into several rings to improve the appearance. As microwave cooking is not suitable for the preparation of fish chikuwa with regard to development of brown colour and the appearance of fish chikuwa product was not liked by the panelists, it was decided to consider only microwave cooking of fish tubes to be sliced and presented to the consumer. Microwave cooking has advantages over the broiling with regard to harmful compounds and it has several advantages as mentioned earlier.

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