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Quality changes in spice-roasted chicken *(ayam percik)* stored at chill temperature

(Perubahan kualiti ayam percik semasa penyimpanan pada suhu dingin)

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Key words: *ayam percik,* processing, quality changes, chill temperature

Abstract

Ayam percik, an ethnic dish was prepared by marinating chicken portions with marinade containing dry chilli, onion, garlic, ginger, lemon grass and salt before grilling. The ready-to-eat product contained 28.9% protein, 2.7% fat, 3.4% carbohydrate and 154 kcal/100 g energy. *Ayam percik* packed in microwavable plastic containers and high-density polyethylene bags were highly acceptable after 7 days storage at chill temperature. No significant changes were observed chemically, microbiologically and organoleptically throughout the storage period.

Introduction

Traditional home cooking especially ethnic dishes have very good tastes, and regional dishes are popular. One such popular dish is *ayam percik*. One may occasionally prepare the ingredients and follow the elaborative procedures of preparing the dish for the sheer pleasure of doing it. However, on a day-to-day basis, one needs speed and convenience.

Preparation of the *ayam percik* dish involves preparation of the ingredients for the sauce, marinating the chicken in the sauce, followed by grilling and basting of the chicken. It is time consuming. Therefore, any convenient forms relating to *ayam percik*, be it in frozen or in a chilled form, would introduce options to consumers. It would allow consumers preparing the dish to spend less time in the kitchen.

The food market is saturated with new food products. Although shoppers do not consciously look for new products, they shop for quality, variety and best buys. They may also accept an exotic new product if presented with one. It is important, therefore, to constantly provide new good quality products with variable flavours and textures and in appropriate forms and packages.

A study was thus conducted to develop *ayam percik* in an acceptable and convenient form. The formulation and processing parameters used in the study were adapted to the appropriate materials and methods of preparation while maintaining the overall flavour of the dish. The product was targeted for consumers who were looking for convenience as well as for those who were looking for simple, familiar and identifiable flavour of *ayam percik*. This paper reports on the quality of the *ayam percik* that has been developed in a convenient form and stored at chill temperature.

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Materials and methods

Sample preparation

Chicken cuts (drumsticks) were obtained from a chicken supplier in Kuchai Lama, Selangor. Raw materials and ingredients used in the basting sauce formulation for *ayam percik* were coconut milk (68%), onion (6%), garlic (0.8%), dry chilli (0.8%), ginger (0.8%), lemon grass (0.4%), prawn paste (0.2%), tamarind (0.8%), flour (1.4%), sugar (3.7%), salt (1.1%) and water (16%). The raw chicken portions were deskinned, washed and marinated with marinade consisting of 8% dry chilli, 66% onion, 8% garlic, 8% ginger, 4% lemon grass and 6% salt for 30 min prior to pre-cooking.

The marinated chicken meats were simmered for 30 min, charcoal grilled for 4 min and basted with basting sauces; grilling and basting steps were repeated four times. Then, the grilled products were blast frozen to –18 ºC, packed in either microwavable plastic containers or high density plastic bags in paper boxes and stored at 4 ºC until evaluation. The chilled products were reheated either in the microwave at 180 ºC for 5 min or conventional oven at 220 ºC for 7 min for evaluation. These reheating parameters were established in earlier preliminary work.

Physicochemical analysis, microbiological status and sensory evaluation

The pH and total soluble solids of marinade and basting sauce were determined by using an Orion pH meter Model 501 and Atago hand held refractometer respectively. Viscosity was determined using Brookfield Digital Viscotester Model DV-II and total titratable acidity by titration method (AOAC 1990). Colour was measured by using Minolta Chroma Meter CR 300; expressed in the L*, a*, b* notational system. The equipment was calibrated using a white tile for the Y, x, y values of 92.5, 0.3134 and 0.3194 respectively.

Chemical analysis was carried out on the basting sauce as well as *ayam percik*. Samples were taken and analysed for moisture, protein, ash, crude fibre, total fat, peroxide value and thiobarbituric acid. Moisture, ash and total fat were determined by the AOAC method (1990). Protein was determined using the Tecator (1987) method while crude fibre by the Tecator (1978) method. Thiobarbituric acid values (TBA) were determined by using the Pearson (1973) method and expressed as mg malonaldehyde/kg sample. Peroxide value (PV) was determined using the AOAC method (1990). Each analysis was carried out in duplicate on one batch of sample for both freshly prepared samples and stored samples. Carbohydrate was determined by the means of difference and energy values were calculated from the protein, fat and carbohydrate results by multiplying the values by Atwater's factors of 4, 9 and 4 respectively. For the data analyses of the above, the SAS (Statistical Analysis System) program release 8.01 was used (SAS 2000). The values obtained were tested using the t-test.

Microbiological examination (total viable count, coliform count, *E. coli*, *Staphylococcus aureus* and Salmonella) was carried out on freshly prepared samples and stored samples using methods recommended by ICMSF (ICMSF 1978). Analysis was in duplicates.

Sensory evaluation was carried out by 25 panel-tasting members of the Food Technology Research Centre, MARDI, Serdang. The chilled *ayam percik* were reheated in microwave oven at 180 ºC for 5 min before they were presented for organoleptic evaluation. Each panellist was asked to evaluate the freshly prepared samples and stored samples for colour, texture, flavour, taste and overall acceptability on a nine point hedonic rating scale, with 9 = like extremely and 1= dislike extremely (Larmond 1977). All data were tested with ANOVA and Duncan Multiple Range Test, using SAS program.

Results and discussion

Chicken portions were immediately deskinned, washed and marinated upon arrival. Marinating is primarily used for flavour incorporation. In *ayam percik* formulation, flavouring marinade and basting sauce are formulated to impart a *percik* flavour profile to the grilled chicken. Salt was included in the marinade for promoting muscle fibre swelling and the uptake of fluid. It was also to improve the product on cooking. Salt was also included in the basting sauces as seasoning to give taste to the sauces. The basting sauce had high total soluble solids compared to the marinade *(Table 1)*. This could be due to the presence of sugar in the formulation. The basting sauce prepared was quite viscous with 8.16 x 10^3 cps. This could be due to the addition of wheat flour in the formulation and evaporation of water during cooking.

The variations in marinade and basting sauce colour are shown in *Table 2*. Marinade had higher 'L' value, i.e. it had a lighter colour compared to basting sauce. However, marinade was more red and more yellow than the basting sauce, and this was reflected by the a* and b* values respectively. The colour of the marinade mainly depends on the original colour of the dried chillies.

Table 1. pH, total soluble solids and viscosity of marinade and basting sauce of *ayam percik*

	Marinade	Basting sauce
PH	4.77a	4.83a
Total soluble solids (°Brix)	10.6a	28.8b
Viscosity (cps)	17.05 x 10^2a	8.16 x 10^3b

Means of 5 batches
Means in the same row followed by the same letter are not significantly different by DMRT (p <0.05)

The moisture content of basting sauce was very high *(Table 3)* because more than 80% of the ingredients used were in the liquid form. The fat content was also quite high and the source of fat came from coconut milk.

Basting sauce has quite high TBA value (1.6 mg malonaldehyde/kg) compared to *ayam percik*. This could be due to oxidative rancidity of unsaturated fatty acid in coconut milk.

Chemical analysis of the *ayam percik* showed that the grilled products have lower fat content *(Table 3)* than the fresh meat and the basting sauce. This could be due to the fact that grilling is a method to obtain the desired searing effect without total oil immersion. It requires manipulation of the meat particles to ensure that all surfaces of the meat become exposed to the grilling surface. In this grilling process, the chicken meat was rendered and searing occurred with the aid of natural juices.

The moisture content of *ayam percik* was quite high (63.1%). However, during chill storage, there was a loss in moisture content of *ayam percik* in both packagings, but the loss was insignificant for *ayam percik* packed in HDPE bags. After 7 days of chill storage, moisture loss of *ayam percik* in HDPE bags and microwavable plastic containers were 1.43% and 2.53%, respectively. *Ayam percik* packed in HDPE bags and sealed in a paper box seemed to have better moisture barrier which resulted

Table 2. Colour of marinade and basting sauce of *ayam percik*

	L* (lightness)	a* (chromaticity coordinate)	b* (chromaticity coordinate)
Marinade	32.52 ± 0.36a	+25.30 ± 0.44a	+28.63 ± 0.50a
Basting sauce	29.21 ± 0.25a	+21.63 ± 0.66b	+22.07 ± 0.36b

Mean of 10 samples
Means in the same column followed by the same letter are not significantly different by DMRT (p <0.05)

Table 3. Chemical composition of basting sauce and a*yam percik* before and after chilling

Chemical composition	Basting sauce	*Ayam percik*		
		Day 0	Day 7	
			MV	HDPE
Moisture (%)	80.8	63.1	61.5	62.2
Protein (%)	1.3	28.9	–	–
Ash (%)	1.7	1.6	–	–
Crude fibre (%)	0.4	0.3	–	–
Total fat (%)	6.8	2.7	–	–
Total carbohydrate (%)	9.0	3.4	–	–
Energy (kcal/100 g)	102.0	154	–	–
Peroxide value (mEq/kg)	0	0	0	1.1
Thiobarbituric acid (mg malonaldehyde/kg)	1.6	0.8	2.5	1.7

MV = Microwavable plastic container
HDPE = High density polyethylene

in least loss of moisture during chill storage. Packaging materials can serve as vapour barriers, preventing entrance of oxygen into the package and loss of water from the product.

The TBA value for freshly prepared *ayam percik* was quite low (0.8 mg malonaldehyde/kg sample) indicating that lipid oxidation did not contribute to off flavour development in this *ayam percik*. Ginger, one of the ingredients used in the prepararation of marinade and basting sauce for *ayam percik* has been reported to have antioxidant activity (Hirahara et al. 1974; Lee et al. 1982; Jitoe et al. 1992). Fujio et al. (1969) reported that the antioxidant activity is from pungent zingerone and shogaol.

However chill storage at 4 ºC for 7 days led to significant increase in TBA value *(Table 3)*, which means that oxidation of fat occurred at that temperature. Increases in TBA values with increasing storage time appears related to oxygen permeability of packaging materials. Small differences occurred between packagings were insignificant.

TBA value was often used to monitor rancidity in meat products. Processing methods such as grinding and chopping result in massive tissue destruction, exposing lipid to oxidation (Hall 1987). Neer and Mandigo (1977) in their study of flaked pork patties reported an increase in TBA value after frozen storage for 18 weeks. Taylor (1987) suggested that proxidants such as ferrum and cuprum from water and spices contribute to the increase in the rancidity of meat products.

TBA value was determined in this study to observe the oxidative deterioration of a*yam percik* during chill storage. Malonaldehyde is a product of secondary oxidation of lipid. Oxidation in meat/fat is a major cause of deterioration in mechanically deboned chicken meat. The myoglobin and hemoglobin from bone marrow increase the oxidation of lipid in mechanically deboned chicken meat. According to Arafa and Chen (1976), although malonaldehyde is commonly used for measuring fat oxidation in meat, the relationship between oxidation and malonaldehyde is not clearly defined.

The peroxide value (PV) was not detected in the freshly prepared a*yam percik*. However, PV was detected in a*yam percik* packed in HDPE bags after 7 days of chilled storage *(Table 3)*. The production of hydroperoxide to peroxide from lipid oxidation is also used in monitoring the shelf life quality of meat products. Miller et al. (1980) reported that the thawing process

Table 4. Microbiological evaluation of *ayam percik* before and after chill storage

Storage (days)	Microbiological tests	MV	HDPE
0	Standard plate count (cfu/g)	<1.0 x 10	<1.0 x 10
	Psychrotrophic counts (cfu/g	<1.0 x 10	<1.0 x 10
	Coliform (MPN/g)	Negative	Negative
	Salmonella in 25 g	Not detected	Not detected
	Staphylococcus in 0.1 g	Not detected	Not detected
1	Standard plate count (cfu/g)	$<3.0 \times 10^2$	$<3.0 \times 10^2$
	Psychrotrophic counts (cfu/g)	<1.0 x 10	<1.0 x 10
3	Standard plate count (cfu/g)	<1.0 x 10	<1.0 x 10
	Psychrotrophic counts (cfu/g)	<1.0 x 10	<1.0 x 10
5	Standard plate count (cfu/g)	<1.0 x 10	<1.0 x 10
	Psychrotrophic counts (cfu/g)	<1.0 x 10	<1.0 x 10
7	Standard plate count (cfu/g)	<1.0 x 10	<1.0 x 10
	Psychrotrophic counts (cfu/g)	<1.0 x 10	<1.0 x 10

leads to oxidation of lipid, causing the development of peroxide.

Microbiological growth was not detected in the freshly prepared a*yam percik* and throughout the storage period *(Table 4)*, except that the standard plate counts were detected on the first day of the chill storage, but the counts were very low and the products were still microbiologically acceptable. This is because during the pre-cooking process (which represent a pasteurisation process), all pathogens particularly salmonella have been eliminated. During this pre-cooking process, the marinated chicken meat was cooked to a temperature of above 70 ºC for 30 min prior to the grilling process.

It has also been reported that low temperature will inhibit most bacteria from multiplying. However, there is the psychrophilic type of bacteria, which are not killed during pre-cooking and will only start multiplying during grilling and cause health hazard to human. *Listeria monocytogenes* is an example of psychrophilic bacteria, which can grow at refrigerated temperature (Berrang et al. 1989). These bacteria can cause miscarriage to pregnant women and death to the newborns.

These results showed that a*yam percik* with suitable packaging could be stored at chill temperature of 4 ºC with low risk of microbial growth, especially psychrophilic bacteria. Product is thus, ensured of not becoming spoiled if used up to 7 days at this chill temperature. However, according to Frazier and Westhoff (1988), existence of certain bacteria species can contribute towards deterioration of taste and flavour.

Mean scores for sensory attributes during storage at 4 ºC were determined and values with freshly prepared samples were compared *(Table 5)*. The results showed that the freshly prepared *ayam percik* was well accepted by the panel members. The products prepared were delicious, tender and tasteful. The basting sauces used in preparing *ayam percik* assisted in imparting a flavour sensation to the chicken, which was complementary to the intended eating experience. Apart from that, the sauce also created an appearance and colour that satisfied eye appeal and fortified the subsequent tasting experience. However, the chilled samples were rated lower than the freshly prepared samples, but they were still acceptable and did not show any sign of deterioration in terms of spoilage and rancidity. Panel members were not able to differentiate between freshly prepared a*yam percik* and chilled a*yam percik*. All values fall within the range of 5.92–7.48 for the chilled samples. The scores were all above 5.90 indicating chill storage had no

Table 5. Mean scores for sensory evaluation for *ayam percik* during chill storage

Storage period (days)	Types of packaging	Colour	Flavour	Hotness	Taste	Overall acceptance
0	Freshly prepared samples	7.48	7.36	6.32	6.94	6.90
1	MV	7.48	6.92	6.68	6.70	6.88
	HDPE	7.04a	7.44a	6.24a	6.78a	6.82a
2	MV	7.10a	6.90a	6.38a	6.60a	6.54a
	HDPE	7.28a	7.20a	6.24a	6.86a	6.82a
3	MV	6.79a	6.79a	6.83a	6.88a	6.83a
	HDPE	6.75a	6.96a	6.63a	6.67a	6.83a
4	MV	7.21a	6.96a	6.71a	6.75a	6.75a
	HDPE	7.08a	7.13a	6.79a	7.08a	6.74a
7	MV	6.75a	6.58a	5.96a	5.92a	6.08a
	HDPE	6.79a	6.96a	6.54a	6.71b	6.71b

Mean of 25 taste panellists
Means in the same column followed by the same letter are not significantly different by DMRT (p <0.05) except for taste (p <0.01)

significant influence on the sensory attributes of a*yam percik* evaluated.

However, on the seventh day of chill storage, samples packed in HDPE bags were preferred over those packed in microwavable container in terms of taste and overall acceptability. There were significant differences (p >0.01) in the taste and (p >0.05) in the overall acceptability of chilled samples packed in HDPE bags and packed in microwavable container.

In the market today, raw packed marinated chicken meat and cooked *ayam percik* are already making entry in major supermarkets. It will not be long before we see ready-to-eat *ayam percik* in chilled or frozen form available in market.

Conclusion

Chilled *ayam percik* produced was found to be as original as those freshly prepared in terms of taste, flavour, texture and colour. The sensory attributes of importance to *ayam percik* such as flavour, texture and appearance are well accepted.

An acceptable chilled *ayam percik* can be produced to meet consumer demand for a convenient form of *ayam percik*. It would introduce an option to consumers in particular to those who are looking for convenient ways of preparing foods without sacrificing their leisure time and working hours.

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Abstrak

Ayam percik merupakan masakan etnik yang disediakan dengan memerap potongan ayam dengan bahan pemerap yang terdiri daripada cili kering, bawang merah, bawang putih, halia, serai dan garam sebelum dipanggang. Ayam percik ini mengandungi 28.9% protein, 2.7% lemak, 3.4% karbohidrat dan 154 kcal/100 g tenaga. Ayam percik yang dibungkus di dalam bekas plastik tahan gelombang mikro dan beg polietilena berketumpatan tinggi masih amat disukai selepas disimpan selama 7 hari pada suhu dingin. Sepanjang masa penyimpanan pada suhu dingin, tidak terdapat sebarang perubahan yang ketara dari segi kimia, mikrobiologi dan organoleptik pada ayam percik.

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