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Full Length Research Paper

Effect of film perforation and modified atmosphere on the sensorial quality of Camembert cheese

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Abstract

Camembert is a soft cheese that is highly perishable because of its high nutritional value and moisture content. This study examined the effect of using two different films of different permeability on the extension of the shelf-life of the cheese samples. The samples were prepared at Cheese cellar, London, and analysed at the food science laboratory of London South Bank University, London. The two films used were of the same food grade material i.e. polyethylene terephthalate (PET). One film had perforations (*Mp*), while the other is a non-perforated film (*M*). Without perforations, the permeability of the film for water, O_2, CO_2 and N_2 is 3.9g/m^2 /24hours at 38 ^oC, 3cm^3/m^2 /24hours at 23 ^oC, 30cm^3/m^2 /24hours at 23 ^oC and 3cm^3/m^2 /24hours at 23 ^oC respectively. The two sets of samples were stored at 4 ± 0.5^oC and studied for a period of three weeks. The samples were randomly selected in duplicates on day 0 (of week 1), day 7 (of week 2), and day 14 (of week 3). Changes in the sensorial properties of the food samples were assessed. The effect of the two films on the sensory attributes of firmness and odour of the cheese was studied. After 14 days period of storage of the two sets of samples, the firmness of sample *M* (packed using non-perforated film) had reduced greatly as compared to sample *Mp*(packed using perforated film). Sample *M* also produced more intense off-odour of ammonia i.e. sample *M* reached the end of its sensorial shelf-life faster than sample *Mp*. Based primarily on sensory evaluation, the use of perforated film (*Mp*) preserved the sensory attributes of firmness and aroma of the Camembert cheese more than the non-perforated film.

Keywords: *Film perforations, Camembert and cheese*

INTRODUCTION

Camembert, an important member of the soft cheeses, is commonly consumed in various countries for its unique taste and nutritional value.

An important determinant of the shelf-life of cheese, such as Camembert, is its high moisture content, nutritional quality and pH.

Consequently, they are very susceptible to spoilage by moulds, yeasts, and enteric bacteria. (Papaioannou *et al*, 2007).

The quality and shelf-life of this cheese is usually few days after ripening, depending on factors such as temperature of storage (Rodriguez-Aguilera *et al*, 2011), packaging technology used, oxidation of fats, microbiological contamination, loss of moisture (Air products, 1995) Therefore, the extension of the shelf life of this soft cheese, and keeping it fresh for a longer period of time is a matter of importance.

Consumer demands for natural, healthy, preservatives-free products with extended shelf-life, have led food technologists and researchers to develop new packaging concepts. Among these new packaging concepts is the modified atmosphere packaging (MAP). MAP changes the natural gas composition surrounding the product in the package in order to delay deteriorative changes (Air products, 1995; Maria R. B., 2009). MAP technologies increase commercial life of cheeses because they combine the protection against oxidation and dehydration with the inhibition of undesirable microorganisms (Olivares *et al*, 2012)

MAP of different cheese varieties has been studied in the last decades (Rodriguez-Aguilera *et al*, 2011), but

scarce information related to MAP of Camembert cheese is available.

The permeability and the transmission rate of the packaging film to O_2, CO_2, and water vapour are among the most essential factors which determine the gas composition in the package, which may influence the product's deterioration rate (Mullan and McDowell 2003; Church 1994).Therefore, the MAP design for a product requires careful handpicking of the packaging film type and size of packaging for the product (Farber *et al*. 2003).

For packaged cheeses, the thermodynamic driving force for water transfer out of the cheese and out of the package depends on the barrier to moisture that the package offers (Holm et al, 2006)

The cheese under study is a cylindrical, cream coloured, mould-ripened cheese. Traditionally, Camembert tends to be sold whole in thin, round, wooden containers. The product is also commonly wrapped dry in a paper/foil wrapper. These systems of packaging may lead to excessive water loss from the product. On the other hand, using a barrier film that has very low permeability to water will not produce a desirable quality for these cheeses. The Camembert cheese under study does not last more than 7 days after it has been unwrapped, cut and repacked by the retailer in a MAP, using non-perforated film.

The shelf-life of this type of cheese could be extended by allowing water loss, but at a lower rate. Selecting a packaging film with the right permeability to water could be challenging, but identifying the correct packaging film for cheeses has been noted to be the key to extending the shelf-life of this type of cheeses (Simal et al, 2001)). The use of a packaging system with a tailor-made moisture barrier, which allows for water loss, but at a lower rate, is a way of extending the cheese's shelf-life (Pantaleao et al., 2006). The final choice on the packaging film to be used should be made based on vast evaluations and in collaboration with the packaging suppliers (Sandhya, 2010). Although, MAP with 30% CO2 and 70% N2) is recommended for soft cheeses, it is not used for mould-ripened soft cheeses (Air product, 1995). Also, perforated films are often used for fresh produce such as fruits and vegetables i.e. this is the first study evaluating the effect of modified atmosphere (MA) and a perforated film on Camembert cheese.

The study examined the effect of using two films of same food grade material polyethylene terephthalate (PET), but of different permeability, and a modified atmosphere of 60% CO2 and 40% N2on the sensory quality of Camembert cheese.

MATERIALS AND METHODS

The study evaluated the effect of the two packaging films on the firmness and odour sensory attributes of the food samples. The methodology used for the study is described below.

Food sample preparation

Twenty samples were collected from the delivery unit of Cheese cellar, London, and taken to the production unit (of the same food company), where each was unwrapped and cut into 8 wedges, using a clean wedge line cutter. The wedges were placed in trays (each wedge weighing approximately 30g). The packaging trays were then separated into 2 groups.

The Multivac's MAP machine which uses preformed tray and lidding film (PTLF) was used for the sample preparation. The machine was used to evacuate air from the package and to seal the trays with the 2 different films, after the addition of protective gases (CO2, N2)at pre-set levels. The gas mixture used for the study was 60% CO2and 40% N2..

The samples were then stored at 4 ± 0.5 oC in the storage room of the factory. Duplicate samples were randomly collected and analysed. The samples were held at ambient temperature during the evaluation of the sensory attributes of the samples. A two-week study was conducted, before the final three-week study. The different samples were labelled using different code. Letter M was used for the Camembert cheese packaged using non-perforated film, while letter Mp was used for the Camembert cheese packaged using perforated film. Numeric subscripts such as 1, 2, and 3 were used to differentiate samples collected in different weeks (i.e.1 for day o of week 1, 2 for day 7 of week 2, and 3 for day 14 of week 3)

Perforated films

A roll of perforated PET film (with a thickness of 7.5 µm) made from needles of of 0.15 mm was kindly supplied by Cheese cellar, London. The number of perforations per square centimetre of the film is 15.

Sensory evaluation

The vocabulary to be used for the sensory assessment was developed. The vocabulary used included the texture attribute of firmness and odour attribute of the off-odour of ammonia or gym socks.

A modified form of the Basic Storage Design, commonly used for performing sensory shelf-life experiment (Hough, 2010) was used. The approach consists in storing a single large batch of product under Normal conditions and testing it at various storage

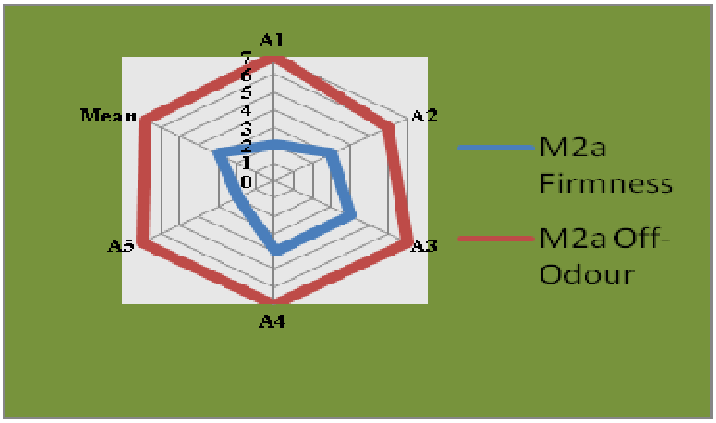

Figure 1: Showing lesser score of firmness and higher score of off-odour for sample M2a from second week of preliminary study

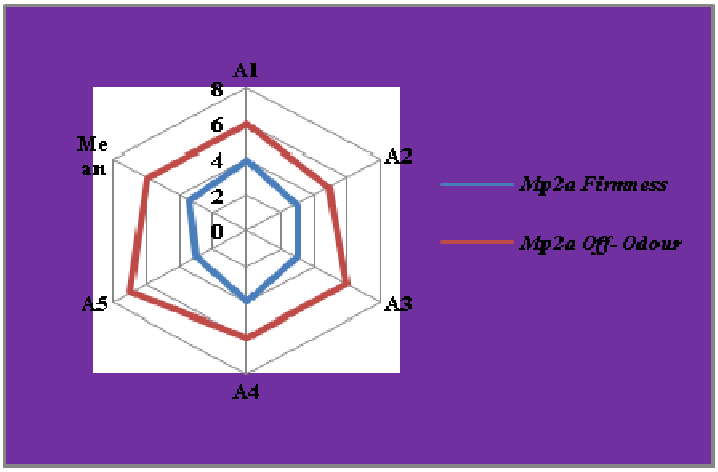

Figure 2: showing higher score of firmness and lesser score of off-odour for sample Mp2a from second week of preliminary study

times (Lawless and Heymann, 2010).

Sample preparation

Thirty gram portion of the Camembert cheese was weighed out from the different trays sealed with different films. Two different spatulas were used to transfer the different samples into different 250ml beakers. The samples were coded using different non-suggestive letters.

Sensory assessment

To evaluate the sensory properties of the cheese portions, all the samples were submitted to five trained assessors familiar with this type of cheese. The panel scored two descriptors by consensus: The texture attribute of firmness and the odour attribute of the off-odour of ammonia.

The core firmness was estimated by the ease with which the cheese could resist to the finger pressure. The score used is similar to the 9 point hedonic scale. The score varied from extremely soft (score of 0) to extremely hard (score of 10). The intensity of the off-odour produced was assessed by placing 30g each of the 2 different samples in two different 250ml beaker. The two samples were then presented to the assessors. Each assessor sniffed the headspace in one sample for 1min, recorded a score for the sample, breathed in some fresh-air, and then repeated the process for the second sample. The score varied from 0 (absence of off-odour of ammonia) to 10 (very intense off-odour of ammonia).

The data were collected on paper and translated using radar diagram shown in figures. 1, 2, 3 and 4.

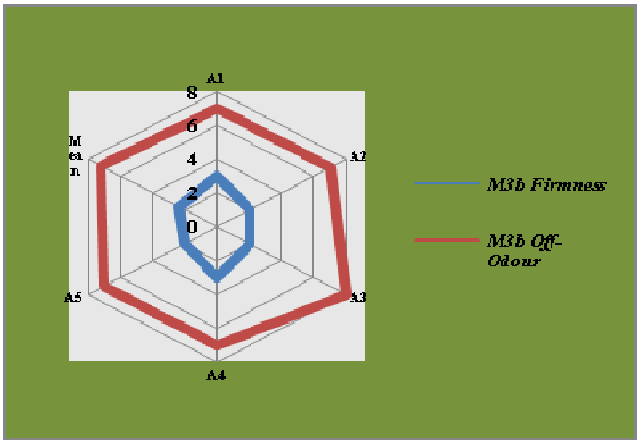

Figure 3: Showing lesser score of firmness and higher score of off-odour for sample M3b from 3rd week of final study

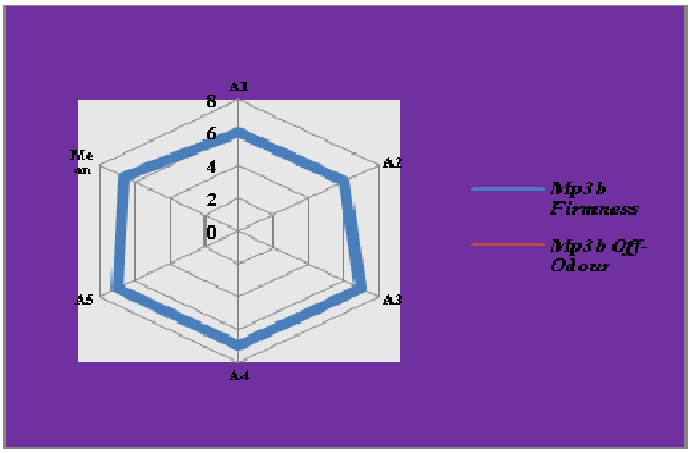

Figure 4: Showing very high score of firmness and Zero score of off-odour for sample Mp3b from 3rd week of final study.

RESULTS AND DISCUSSION

Camembert cheese is known to reduce in firmness or hardness when it is near the end of its shelf-life. Camembert cheese changes from firm to very soft, and then turns into a thick liquid with pungent odour of ammonia. It is then said that the Camembert cheese is runny. Differences in the firmness and off-odour of the two sets of samples were evaluated at the last week of preliminary and final study. The sensory scores from the assessment are shown in table 1 and table 2.

The sensory scores for texture and odour attributes showed a similar pattern, with progressively decreasing acceptability for samples stored using non-perforated film (M).

For the preliminary study, sample M received a mean firmness score of 3, while sample Mp received a mean firmness score of 3.4. For the odour attribute, sample M received a mean off-odour score of 6.8, while sample Mp received a mean off-odour score of 6.

For the final study, sample M received a mean firmness score of 2.4, while sample Mp received a mean firmness score of 6.6. For the odour attribute, sample M received a mean off-odour score of 7.2, while sample Mp received a mean off-odour score of 0. See table 1 and 2.

Considering a firmness score of 3.0 as corresponding to the end of the product's shelf-life, cheese samples stored using perforated film achieved a longer shelf-life up to 14 days. It was observed that the perforated film has the potential to preserve the sensory qualities of the Camembert cheese for over 14days i.e. after cutting, repacking, and storing the product at 4 ± 0.5oC.

For sample M, the inhibitory effect of the high % CO2 on the mould responsible for ripening of the Camembert cheese may have supported the proliferation of resistant

Table 1. Sensory score of the Camembert cheese packed using non-perforated film (M2a) and perforated film (Mp2a). A=Assessors, M2a =Sample from 2nd week of preliminary study packed using non-perforated film, Mp2a = Sample from 2nd week of preliminary study packed using perforated film.

Attribute terms for M2a	***A1***	***A2***	***A3***	***A4***	***A5***	***Mean***
Firmness	*2*	*3*	*4*	*4*	*2*	*3*
Off- Odour	*7*	*6*	*7*	*7*	*7*	*6.8*
Attribute terms for Mp2a	***A1***	***A2***	***A3***	***A4***	***A5***	***Mean***
Firmness	*4*	*3*	*3*	*4*	*3*	*3.4*
Off- Odour	*6*	*5*	*6*	*6*	*7*	*6*

The sensory scores from preliminary study

Plate 1 Showing sample M2 (packaged using non-perforated film), already exhibiting runny sign.

Plate 2 Showing sample Mp2 (packaged using perforated film), exhibiting slight runny sign.

Table 2: *Sensory score of the Camembert cheese packed using non-perforated film (M3b)and perforated film (Mp3b).A=Assessors,M3b =Sample from 3rd week of final study packed using non-perforated film,Mp3b = Sample from 3rd week of final study packed using perforated film.*

Attribute terms for M3b	***A1***	***A2***	***A3***	***A4***	***A5***	***Mean***
Firmness	*3*	*2*	*2*	*3*	*2*	*2.4*
Off- Odour	*7*	*7*	*8*	*7*	*7*	*7.2*
Attribute terms for Mp3b	***A1***	***A2***	***A3***	***A4***	***A5***	***Mean***
Firmness	*6*	*6*	*7*	*7*	*7*	*6.6*
Off- Odour	*0*	*0*	*0*	*0*	*0*	*0*

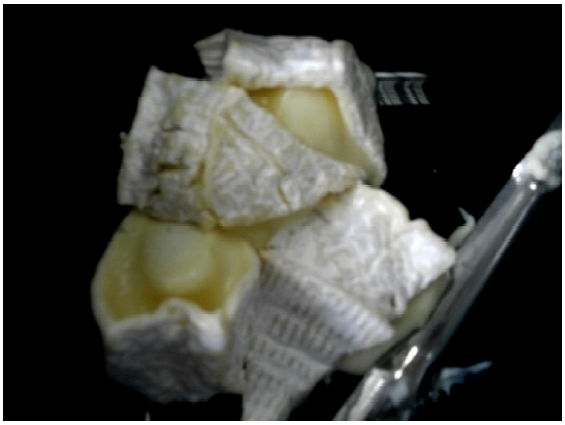

Plate 3. Showing sample M3 (packaged using non-perforated film), exhibiting prominent runny sign

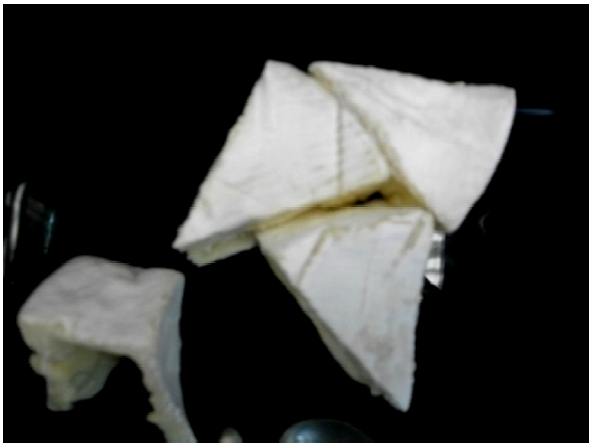

Plate 4.Showing sample Mp3 (packaged using perforated film), not exhibiting any runny sign

psychrotrophic /microaerophilic bacteria and yeasts. Yeasts are facultative anaerobes known to survive underaerobic and anaerobic conditions. They can also be resistant to the antimicrobial effect of excess level of CO2. The biodeteriorating activities of these psychrotrophic / microaerophilic bacteria and yeasts may have contributed to the impairment of the sensory attributes of sample M.

The harder texture of sample Mp can be attributed to the higher moisture loss from the sample Mp through the perforated film. Higher moisture loss has been attributed to increase in the firmness of cheeses (Pantaleaoet al, 2006).

Although, it is often said that MAP under low oxygen levels is beneficial in inhibiting undesirable oxidative off-flavours and off-odours, the MAP with higher oxygen level produced less off-odour. This can be explained by considering the high %CO2 in the MAP with less oxygen. Excess level of CO2 has been noted to contribute to the tainting of the flavour of food products.

Also, the high amount of N2, allowed by the perforated film may have led to extension in the life of the product i.e. N2 has the potential to delay the oxidative rancidity of dairy products (Air products, 1995)

CONCLUSIONS

The study revealed that the high CO2 content may not be appropriate for mould-ripened cheese, such as Camembert. In addition, the study has revealed that the use of the perforated film has a good potential for preserving the sensory attribute of firmness and fresh dairy odour of the Camembert cheese i.e. Based primarily on sensory evaluation, the use of the perforated film could preserve the sensory attributes of firmness and aroma of the Camembert more than fourteen days (after cutting and repacking by the retailer).

The result of the study is consistent with the reasoning of some specialists on MAP that mould-ripened cheeses should not be preserved using modified atmosphere (Air products, 1995), because the CO2 may affect the mould growth and hence the quality of the cheese.

The research has revealed that low level CO2 in the ranged of 0.2 -4% may be desirable for mould-ripened soft cheeses, such as Camembert.

This is the first study reporting on the use of MAP and perforated film for extension of the shelf-life of Camembert cheese. It must, however, be noted that these recommendations on MAP packaging conditions for Camembert cheese correspond to samples from one cheese factory and thus their general application is yet to be verified.

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