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Evaluation of sensory quality of paneer with casein based edible coating incorporated with essential oil

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Abstract
The present study was conducted to select the type and level of essential oil to be incorporated into a sodium caseinate based edible coating for paneer. The edible coating solution was prepared using sodium caseinate, glycerol and pectin solution to which different levels of clove, oregano and parsley essential oils were added. Clove bud essential oil treated edible coating was selected based on the sensory scores obtained for the coated paneer. Further the levels of incorporation of clove bud essential oil was optimised as 0.25% of the coating solution based on the sensory scores obtained by a panel of 5 semi trained judges.

Keywords: Evaluation, sensory, quality, coating, incorporated

1. Introduction
Paneer is a heat acid coagulated milk product popular throughout South Asia. As generally prepared from buffalo milk, it is characterized by marble white colour, sweetish, nutty flavour and mildly acidic taste, smooth and spongy body with a closely knit texture. [1] However, a major hurdle in the production of paneer at commercial level is its relatively shorter shelf life. Bhattacharya *et al.* (1971) [2] reported that paneer lost its freshness after 3 days and could only be stored for 6 days at 10 ºC without much compromise in the quality. Lipid oxidation is one of the major reason for spoilage in dairy products rich in poly unsaturated fatty acids. As a result of this oxidative deterioration, peroxides are formed which could be responsible for the undesirable rancid flavour as it also adversely affect the shelf life of the product (Gad, A.S. and Sayd, A.F, 2015) [3]. Food additives like chemical anti-oxidants (tertiary butylhydroquinone (TBHQ) and butylated hydroxyl anisole (BHA), sorbic acid, Hydrogen peroxide solutions, Pottasium sorbate, delvocid etc.) have proven to increase the shelf life of paneer (Sachdeva and Singh, 1990) [4] (Kumar and Bector 1991) [5]. But, as the population all over the world demands for healthier food products, the development of methods comprising natural components for the preservation of paneer is highly appreciated (Raju, A & Sasikala, 2016) [6].
Incorporation of bioactive components into dairy products prevents the oxidative damage during storage by enhancing its anti-oxidant properties and also improves the health benefits of the product. Essential oils from plants are rich in bioactive compounds like cinnamamic aldehyde in cinnamon bark, eugenol (clove bud, Basil leaf, bay and cinnamon leaf) which can be used as alternatives to the chemical anti-oxidants used [7]. However, due to its strong flavour and hydrophobicity, direct application of essential oil into foods is less recommended. Therefore incorporation of an essential oil into a carrying system compatible to the product is to be developed [8].
Edible films and coatings based on natural ingredients offer one of the most hopeful approaches for the food products' shelf life and quality improvement [9]. Films are typically thin layers of materials that are used as wraps, covers, partition layers etc., while edible coatings are a part of the final product, forming the film directly onto the food surface [10]. In order to improve the quality and safety of food edible films and coatings are used as a carrier of coloring agents, flavouring agents, anti-oxidants, antimicrobials and growth regulators [11]. Essential oil incorporated edible coatings are regarded as an efficient and innovative method in enhancing the quality of food.
In the present study, attempts were made to incorporate essential oil onto casein based edible coatings at different levels to obtain a suitable level of incorporation with a sensory quality comparable with the control.

2. Materials and Methods

2.1. Materials

Buffalo milk, procured from University Dairy Plant, Kerala Veterinary and Animal Sciences University was standardised to 6% fat for the preparation of paneer. Sagar Skimmed milk powder from Amul was used for the preparation of Sodium Caseinate. Food grade ingredients like Pectin and Glycerol was procured from CKS Products, Ernakulam. The chemicals for preparation of preparation of Sodium Caseinate was procured from Merck. The essential oils were provided by Synthite Industries Private Ltd, Ernakulam.

2.2. Preparation of Paneer

Paneer was prepared as per the procedure by Bhattacharya *et al.* (1971) [2].

2.3. Selection of type and levels of essential oil

Essential oils of clove bud, oregano and parsley were was added at the rate of 0.25%, 0.5% and 1% each of the coating solutions and the paneer coated with these were subjected to sensory analysis in order to select the type of essential oil to be incorporated on to the edible coating. On the basis of sensory scores obtained, a desired type and level of essential oil was selected.

2.4. Coating of paneer with edible coating

Acid casein prepared from skimmed milk was used to make sodium Caseinate as per the procedure given by Sarode A.R. *et al.* (2016) [12]. Casein based coating was prepared as per the procedure standardized by Bonnaillie *et al.* (2014) [13] with minor modifications. Edible coating solution was prepared using sodium caseinate, glyecrol, pectin and essential oil. The coating solution was prepared by adding glycerol and pectin to sodium caseinate solution. The solution was blended thoroughly using a magnetic stirrer for 30 minutes. After complete dissolution, essential oil was added in different levels. The addition of essential oil was followed by 1 hour of magnetic stirring to make the solutions homogenous. Paneer cubes were dipped in the coating solutions for one hour followed by drying at room temperature for 1 to 2 hours.

2.5. Sensory analysis (9point hedonic scale)

Paneer coated with casein based edible coating with different types and levels essential oil, were subjected to sensory analysis against the traditional paneer (control sample). A panel of 5 semi trained judges were selected and the parameters like flavour, color and appearance, body and texture and overall acceptability were examined. Based on the sensory scores, an optimum product with desirable level of essential oil was selected.

2.6. Statistical analysis

The data obtained from the sensory analysis were analyzed statistically using Kruscal Wallis test (equivalent non-parametric test for one way ANOVA).

3. Results and Discussion

3.1. Selection of type and levels of Essential oil

The type of essential oil more compatible with the paneer had to be selected for incorporation. Clove bud, oregano and parsley essential oils were selected for the incorporation in edible coating for paneer. Each essential oil was added at 3 levels i.e. 0.25%, 0.5% and 1% of the total coating solution. The coated paneer samples were subjected for sensory analysis against the control sample and the results were statistically analysed. (Table 1).

Table 1: Effect of different types and levels of essential oil on the sensory scores of paneer

Parameter	Flavour	Body and Texture	Colour and appearance	Overall acceptability
T1	8.2 ± 0.120^{a}	8.17 ± 0.200^{a}	$8..23 \pm 0.135^{a}$	8.12 ± 0.152^{a}
C1	8 ± 0.223^{a}	8.16 ± 0.106^{a}	8.08 ± 0.083^{a}	8 ± 0.129^{a}
C2	7.25 ± 0.214^{a}	7.16 ± 0.166^{a}	7.33 ± 0.166^{ab}	6.85 ± 0.173^{ab}
C3	6 ± 0.224^{b}	6.3 ± 0.105^{ab}	6.66 ± 0.211^{ab}	6.08 ± 0.083^{b}
O1	7.16 ± 0.105^{a}	7.33 ± 0.210^{a}	7.33 ± 0.166^{ab}	7.25 ± 0.111^{a}
O2	6.08 ± 0.083^{b}	6.75 ± 0.170^{ab}	6.66 ± 0.166^{ab}	6.41 ± 0.153^{ab}
O3	5.417 ± 0.239^{b}	5.917 ± 0.201^{b}	6.083 ± 0.083^{b}	5.5 ± 0.342^{b}
P1	7.08 ± 0.083^{a}	7.58 ± 0.153^{ab}	7.5 ± 0.182^{a}	7.41 ± 0.200^{a}
P2	6.5 ± 0.182^{ab}	6.83 ± 0.210^{ab}	6.75 ± 0.214^{ab}	6.58 ± 0.153^{ab}
P3	5.25 ± 0.25^{b}	5.83 ± 0.211^{b}	5.91 ± 0.201^{b}	5.25 ± 0.31^{b}
Chi Square Value	52.196**	48.025**	46.869**	51.612**

** - significant at one percent ($p \leq 0.01$), Figures are mean±standard error of three replicates, T_1- control sample (without coating), C1, C2, C3- paneer coated with Clove bud essential oil at levels 0.25%, 0.5% and 1% respectively, O1, O2, O3- paneer coated with Oregano essential oil at levels 0.25%, 0.5% and 1% respectively, P1, P2, P3- paneer coated with Parsley essential oil at levels 0.25%, 0.5% and 1% respectively, Means with different superscript (a,b) vary significantly.

The chi square (χ^2) values for flavour, body and texture, color and appearance and overall acceptability of different types of essential oil levels were found to be 52.19, 48.02, 46.86 and 54.61 respectively and showed a significant difference at one percent level ($p \leq 0.01$). A pairwise comparison based on Kruscal Wallis test reveals that the treatment C1 (0.25% clove bud essential oil) scored the highest among all the treatments and had no significant difference when compared to the T1 (control). At 0.5% and 1% levels, all the essential oils gave a sharp taste and yellowish color to the coated product which led to least sensory scores. Hence the clove bud essential oil at 0.25% of the total solution was taken for further studies. Dipping paneer in clove bud essential oil containing water imparted a preservative effect to the paneer thus increasing its shelf life by about 2 times than the control paneer when stored at 8±1 ºC. (Khatkar, A.B. *et al.* 2017) [7].

3.2. Selection of levels of Clove bud essential oil

Based on the results of the preliminary trials conducted, clove bud essential oil was selected for the incorporation into the coating solution. Also, it was understood from the sensory scores that a level of incorporation of essential oil above 0.5% of the coating solution would be undesirable for the product. Therefore, the levels of addition were selected as 0.15%, 0.25%, 0.35% and 0.45% of the total solution. Sensory analysis was done and the data was statistically interpreted. (Table 2)

Table 2: Effect of different levels of Clove bud essential oil on sensory scores of paneer

Parameters	T1	TC1	TC2	TC3	TC4	Chi square value
Flavour	8.1±0.157[a]	6.9±0.100[ab]	7.78±0.073[a]	7.74±0.100[a]	6.31±0.167[b]	19.234**
Body and Texture	8.2±0.214[a]	6.3±0.200[b]	7.74±0.128[a]	7.57±0.070[a]	6.57±0.070[ab]	19.545**
Colour and appearance	8.4±0.200[a]	6.24±0.106[ab]	7.57±.172[a]	7.45±0.050[a]	6.2±0.094[b]	21.022**
Overall acceptability	8.2±0.092[a]	6.3±0.200[b]	7.82±0.145[a]	7.66±0.120[a]	6.25±0.112[b]	20.065**

**- Significant at one per cent level ($p< 0.01$), [a-b] Figures in a row bearing different superscript differ significantly, T1-Control paneer, TC1- Paneer treated 0.15% essential oil, TC2- Paneer treated 0.25% essential oil, TC3 – Paneer treated 0.35% essential oil, TC4- Paneer treated 0.45% essential oil. Figures are the mean ± standard error of sensory scores by five permenant judges in six replication.

The chi square (χ^2) values for flavour, body and texture, color and appearance and overall acceptability of levels of clove bud essential oil were found to be 19.23, 19.54, 21.02 and 20.06 respectively. (Table 4.5). It can be understood from the results that all the treatments were significantly different at 1% level of significance ($p< 0.01$). A pairwise comparison with Kruscal Wallis test revealed that the treatments TC2 (0.25% clove bud oil) and TC3 (0.25% clove bud oil) had no significant difference with T1 (0% clove bud oil) while the treatments TC1 (0.15% clove bud oil) and TC4 (0.45% clove bud oil) had significant difference with the control and obtained the lowest sensory scores. Clove bud essential oil at 0.15% level had no effect on the paneer while at 0.45% level, it gave a sharp and undesirable taste to the coated paneer. Badola *et al.* (2018) [14] reported that the sensory attributes of burfi incorporated with clove bud essential oil above 0.25 mL/kg had the minimum sensory scores. Therefore, based on the sensory scores obtained, the optimum level of clove bud essential oils were selected as 0.25% of the total solution.

4. Conclusion

In the present study edible coating solutions were prepared by the addition of different types of essential oils at different levels from which clove bud essential oil was selected for incorporation on to the coating. As the next step, the optimum level of incorporation of clove bud essential oil was selected as 0.25% based on the sensory analysis. The paneer coated with 0.25% clove bud essential incorporated casein based edible coating was found to have good sensory scores and had no significant difference with that of the control. Hence it can be concluded that the incorporation of clove bud essential oil at the optimum level enhanced the sensory quality of the product.

5. Acknowledgement

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