Paneer is one of the traditional dairy products of India, which is analogous to the western cottage cheese. Paneer is a heat and acid coagulated dairy product with permitted organic acid and subsequent drainage of whey followed by pressing. This traditional dairy product has high water activity leading to rapid deterioration at ambient temperatures due to unhygienic practices followed during manufacturing. Since the demand for this product is steadily increasing, there is a great need to produce high quality long life products that requires hygienic modern processing, preservation and packaging technologies. Hence this study was conducted to improve the useful lifespan of paneer by edible coating technology. Whey protein edible coating was prepared by using whey protein concentrate (6 %), glycerol (7 %) as plasticizer and plant essential oil (ginger oil) as anti microbial agent. Preliminary trials (Control, T1, T2, T3, T4, T5 and T6) were conducted using essential oil (ginger oil) at six different levels (0.2%, 0.4%, 0.6%, 0.8% 1.0 and 1.2 %). Based on the sensory evaluation, incorporation of ginger oil up to a level of 1 % into edible coating recorded significantly higher (p<0.05) scores in overall acceptability.

**Organoleptic Properties**

Organoleptic properties of paneer were assessed in terms of appearance, texture, flavor and overall acceptability. Sensory evaluation was carried out in a randomized complete block design with six treatments and 3 replicates. Each sample was evaluated by 10 trained panelists using a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely.

**Results**

The results revealed that the incorporation of ginger oil significantly improved the organoleptic properties of paneer. The highest scores were observed in paneer incorporating ginger oil at 1.2% level. The sensory profile of paneer with ginger oil was characterized by a mild acidic flavor with slightly sweet taste, and a soft, cohesive and compact texture. It is an excellent substitute for meat in Indian cuisine.

**Material and Methods**

A study was carried out at the Department of Livestock Products Technology (Dairy Science), Veterinary College and Research Institute, Namakkal, to develop protein based edible coating incorporated with essential oils to assess the sensory quality of the product. Paneer was prepared by using superior quality ingredients.

**Dairy Ingredients**

**Cow milk:** Fresh milk containing above 4 % fat and 7.9 % Solids Not Fat obtained from crossbred cows maintained at the Instructional Livestock Farm Complex, Veterinary College and Research Institute, Namakkal, Tamil Nadu was used for the study.

**Whey protein concentrate** (WPC): Whey protein concentrates (containing 82 % protein) obtained from the Kanishka Flora ChemInida, Chennai, Tamil Nadu was used.

**Non-dairy ingredients**

**Essential oil (EO):** Ginger oil- certified food grade essential oil.

**References**

FSSR (2016). Paneer is defined as a product obtained from cow or buffalo milk or combinations thereof by precipitation with sour milk, lactic acid or citric acid. It shall not contain more than 70 % moisture and milk fat content shall not be less than 50 % of the dry matter. The milk fat content of skim milk paneer shall not exceed 13 % of dry matter. Paneer contains all the milk constituents except some soluble whey proteins, lactose and minerals. Paneer has a fairly high level of fat (22-25%) and protein (16-18%) and a low level of lactose (2.0-2.7%).

Paneer is characterized by a mild acidic flavor with slightly sweet taste, and a soft, cohesive and compact texture. It is an excellent substitute for meat in Indian cuisine. This paper describes the Effect of whey protein based edible coat material incorporated with essential oils on organoleptic properties of paneer.
oils were purchased from M/S Akay flavor and aromatics private Limited, Kochi.

Chemicals: Chemicals of analytical reagents (AR) grade procured from HiMedia were used for various analysis and preservation studies.

Selection of ingredients: In order to prepare paneer (4 litre cow milk), citric acid 1 % (1.5ml/lit) were used. Whey protein concentrate (WPC) was used at 6 % level, glycerol (G) was used at 7.0 % and Essential oils (ginger oil) were used at different percentage (0.2 to 1.2 %)

Preparation of paneer:
- Cow milk
- Filtration
- Standardization
- Heating (82°C, 5 min)
- Cooling (70°C)
- Addition of coagulant (1 % Citric acid solution at 70°C)
- Continuous stirring till clear whey separates out
- Settling for 10 min
- Draining of whey
- Pressing the coagulum after filling in muslin cloth lined hoops
- Removal of blocks and cutting into desired size
- Immersion of paneer blocks in chilled water (4°C)
- Draining of water and wiping surface
- Packaging and storage at 4°C

Preparation of WPC edible coating material
- WPC (90% protein)
- Dissolved in distilled water
- Heat Treatment (75-100°C)
- Cooling to room temperature (32°C)
- Addition of glycerol (7 per cent)
- Conditioning
- Brought to room temperature
- Addition of ginger oil (0.2, 0.4, 0.6, 0.8, 1.0 and 1.2 %)
- Thorough Mixing
- Edible Coating material

Application of Edible Coating on Paneer: The edible coat material prepared as per previous research paper.

Essential oil used: Preliminary trials were conducted using ginger oil at six different levels (0.2%, 0.4%, 0.6%, 0.8%, 1.0 and 1.2 %). The best concentration for further studies was selected on the basis of sensory evaluation. Six trails were carried out for each treatment.

Sensory evaluation of paneer: Paneer was coated with edible coated material after inoculating different levels of ginger oil at 0.2, 0.4, 0.6, 0.8, 1.0 and 1.2 % respectively, to study the optimum level for inoculation based on sensory qualities. Panellists were asked to evaluate paneer quality on a 9-point hedonic scale with their preferences according to the scale.

Statistical analysis: The data obtained in all the experiments were analyzed statistically analyzed by ANOVA.

RESULTS AND DISCUSSION

Standardization of ginger oil inclusion level in whey protein based edible coat material by sensory evaluation:

Mean ± SE values of colour and appearance, flavor, body and texture and over all acceptability scores of different concentration of ginger oil (0.2 (T1), 0.4(T2), 0.6(T3), 0.8(T4), 1.0(T5), and 1.2(T6), %) included in whey protein based edible coat material are presented in Table-1 and Fig.-1.

Colour and appearance score:
- Control, T1, T2, T3, T4, T5 and T6 were 7.91±0.08, 7.66±0.10, 6.83±0.21, 6.58±0.15, 6.00±0.18, 5.91±0.30 and 3.91±0.23, respectively. Statistical analysis revealed that inclusion of ginger oil in edible coat material significantly (P<0.05) reduced the colour and appearance scores over control and T1, whereas there was no significant difference between T2 and T3. Similarly, there was no significant difference between T4 and T5. But, addition of ginger oil at 1.2 per cent level significantly (P<0.05) reduced the colour and appearance score over all the other treatments and control.

Body and Texture score:
- Control, T1, T2, T3, T4, T5 and T6 were 7.58±0.23, 7.41±0.27, 7.25±0.21, 6.91±0.15, 6.75±0.17, 6.58±0.23 and 3.66±0.24, respectively. Statistical analysis revealed that inclusion of ginger oil at 1.2 % level in edible coat material significantly (P<0.05) reduced the body and texture scores over control and all other treatments, whereas there was no
Flavour score: Flavour scores for control, T1, T2, T3, T4, T5 and T6 were 77.75±0.17, 7.75±0.21, 7.60±0.24, 7.66±0.24, 8.00±0.15, 8.08±0.15 and 7.83±0.22, respectively. Statistical analysis revealed that inclusion of ginger oil at 1.2 percent level in edible coat material significantly (P<0.05) reduced the flavour scores over control and all other treatments. Even though there was marked increase in the flavor score upto 1 % level of inclusion, the differences were not significant.

Over all acceptability score: Overall acceptability scores of paneer coated with ginger oil was not significantly reduced over the control at 0.6 %, 0.8 % and 1.0 % level of inclusion, whereas beyond 1 % level it showed poor sensory qualities over control and all other treatments. However, the ginger oil inclusion at 0.2 and 0.4 levels significantly reduced the overall acceptability scores over control.

Whey protein edible coating was prepared by using whey protein concentrate (6 %), glycerol (7 %) as plasticizer and essential oil (ginger) as anti microbial agent. Preliminary trials (Control, T1, T2, T3, T4, T5 and T6) were conducted using essential oils (ginger, garlic and cinnamon) each at six different levels (0.2 %, 0.4 %, 0.6 %, 0.8 %, 1.0 % and 1.2 %). In line with the procedure employed by earlier workers, edible coating, the level of whey protein concentrate and glycerol were fixed at 6 and 7 % respectively in the formulation of edible coating.

Further, the procedure of sensory evaluation employed for standardization of edible coat material with essential oil was comparable to that of some earlier workers, who optimized the level of inclusion based on Response Surface Methodology (RSM) while preparing edible coating using whey protein concentrate (WPC), glycerol, potassium sorbate and nisin used as anti microbial agent to enrobe paneer.

On sensory evaluation, the colour and appearance of body and texture of paneer revealed that a significant (p<0.05) decrease in edible coated paneer was observed in all the treatments compared to control. This may be attributed to the natural colour of whey protein concentrate and essential oil.

Further, statistical analysis revealed that inclusion of the essential oil(ginger oil) at 1.2 % level in edible coat material significantly (P<0.05) reduced the flavour scores over control and all other treatments. Even though there was marked
increase in the flavor score up to 1 % level of inclusion, the difference were not significant. On the contrary, some other earlier researchers reported an increase in flavor and overall palatability with samples treated with ginger extract than control 7. The decrease in flavor score may be attributed to the addition of glycerol which might have masked the flavour. The edible coated paneer showed a significant reduction in body and texture it may be due to addition of glycerol in edible coat material. These results were in accordance with earlier researchers, who reported that the glycerol added as plasticizer affected the body and texture while the whey protein concentrates had minimal impact on body and texture 4. The overall acceptability scores of paneer coated with ginger oil was not significantly reduced over the control at 0.6 %, 0.8 % and 1.0 % level of inclusion, whereas beyond 1 % level it showed poor sensory qualities over control and all other treatments.

Based on the sensory evaluation, it is revealed that as the concentration of the mentioned oil up to a level of 1 % incorporation into edible coating recorded significantly higher (p<0.05) scores in overall acceptability, the maximum level of inclusion of up to 1 % was optimized and further studies were carried out. Similarly, the level of incorporation of whey protein concentrate and glycerol were fixed at 6 and 7 % respectively. This was in line with observations of Santoro 8, who reported an improvement in the sensory score observed for cheese added with whey protein concentrate at the rate of 10g/l to milk. Earlier workers also reported that cheese coated with solution 2 or 3 (Lactic acid, natamycin or COS, lactic acid and natamycin) exhibited a yellow-brownish color 4. Furthermore, some workers reported that 6 % whey protein concentrate showed better sensory appearance score than at 8 percent levels of whey protein concentrate 4.

CONCLUSION

Based on sensory evaluation, it is inferred that incorporation of ginger oil up to a level of 1 % into edible coating recorded significantly higher (p<0.05) scores in overall acceptability. It is concluded that formulation of edible coating containing 6 % whey protein concentrate and ginger oil (1 %) may possibly enhance the shelf life of paneer without affecting the organoleptic properties.

REFERENCES