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Changes in hardness of fried edible coated paneer cubes packed under modified atmospheric conditions

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This study pertaining to determining effect on hardness of fried paneer cubes prepared by using composite edible coating and packaged under modified atmospheric packaging (MAP) was conducted in the Department of Food Science and Technology, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttarakhand) during 2011-12. Paneer (Moisture 51.90%, Fat 18.70%, Proteins 17.85%, Ash 2.50%, Titratable acidity 0.24% as lactic acid and pH 5.98) cubes (1.5 cm edge) prepared from buffalo milk (Fat 6% and SNF 9%) as such and coated with composite edible coating (glycerol mono-oleate, glycerol, whey protein concentrate and natamycin) were packed under atmospheric and 4 modified atmospheric (10% CO_2 + 90% N_2, 30% CO_2 + 70% N_2, 50% CO_2 + 50% N_2, 70% CO_2 + 30% N_2) conditions, respectively in PA/PE extrusion-laminated pouches. Packaged samples after storage at 5±1^{0}C and 30±1°C were withdrawn at different intervals of time and subjected to hardness analysis using texture analyzer (TA-XT2i, Stable Micro Systems, UK). A non-significant effect (P=0.01) on the hardness of paneer cubes following frying was found as a result of combination of composite edible coating and MAP.

Key Words : Paneer, Composite edible coating, MAP, Frying, Hardness

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INTRODUCTION

Dairy products are an important food group highly suggested by nutritionists. This food category is one of the most perishable, so extending their shelf life and keeping them fresh for a longer period of time is necessary. Since consumers are now more aware of the possible hazards of preservatives, technologists and researchers have attempted to introduce novel preservative-free methods instead. One of these techniques is modified atmosphere packaging (MAP), which alters the natural gas surrounding the product in the package in order to delay deteriorative changes and the other one is edible coating of food products. Paneer or Indian cottage cheese, an acid and heat coagulated milk product, is highly perishable because of high moisture (58-60 %) and characteristic acidity (pH 5.6-5.8) (Singh *et al*., 1991) and hence, extending its shelf life and keeping it fresh without affecting its aesthetic appeal is a matter of importance. Textural properties of *paneer* and *paneer* like products are important parameters influencing their acceptability. Moreover, in Indian culture, deep fat frying is a widely used method for preparing foods like paneer with an attractive and tasty surface.

Hence, the present study was conceived with the aim to determine the changes that may occur in the hardness of fried paneer due to combination of edible coating and MAP (test) at storage temperatures of 5±1°C and 30±1°C as compared to those stored without edible coating and MAP (control) at the same storage temperatures.

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METHODOLOGY

Fresh buffalo milk was procured from Livestock Research Center, G.B. Pant University of Agriculture and Technology, Pantnagar, Distt. Udham Singh Nagar (Uttarakhand). Fresh standardized buffalo milk was the primary ingredient for manufacture of paneer. Nisin (Christan Hansen (India) Private Limited, Mumbai, Maharashtra) was used as an antifungal agent during preparation of paneer. Whey proteins concentrate (M/s Tropilite Foods Private Limited, Gwalior, M.P), glycerol (M/s Himedia Laboratories Private Limited, Mumbai, India) and natamycin (Danisco India Private Limited, Mumbai, Maharashtra) were the main ingredients for the preparation of edible coating. All the ingredients including citric acid, plasticizer, distilled water, etc. were of food grade. Packaging material *i.e.* extrusion laminated packets (PA/PE) polyamide (40µm) - polyethylene (120µm), size (26 x 15) cm (Make: E-K-Folien, Innovative Product Schutz, Mariaburgstrasse 30, Sweden) for MAP of paneer was used. Modified atmospheric packaging (MAP) machine: VAC-STAR* S 220 MP (Make; VAC STAR, Sugiez, Switzerland) and Gas mixer model: MAP Mix 9001 MK, (Make: PBI Densensor, Ringsted, Denmark) was used for packaging of paneer under MAP. Texture analyzer (TA-XT2i, Stable Micro Systems, UK) with software Texture Expert Exceed Version 7.1.6 was used for analysis of hardness of paneer.

Preparation of paneer :

Paneer was prepared as per the procedure outlined by Sachdeva (1983). The process involved heat treatment of milk to 90^{0}C, for 5 min followed by cooling to 70 ^{0}C followed by mixing nisin and addition of citric acid solution (2.0 %) to achieve coagulation of milk with continuous stirring. Whey was removed thereafter followed by pressing, chilling and cutting into cubes of 1.5 cm edge. Paneer samples thus prepared were stored at 4^{0}C until further use.

Preparation of edible coating :

To prepare composite edible coating, whey protein concentrate (WPC 80%) was dissolved in distilled water and mixed thoroughly to form homogenous solution. This was followed by addition of a plasticizer, fatty acid as a source of lipid and an antimycotic agent into the homogenous mixture. Coating solution was stored at 4^{0}C until further use.

Application of composite edible coating on paneer :

Paneer cubes were dipped in composite edible coating solution until all the surface of cubes was covered with the coating solution while the residual or excess coating solution allowed to drip off. Then coating on cubes was dried in a cabinet dryer at 70±1°C.

Modified atmospheric packaging of paneer cubes :

Freshly coated paneer cubes were subjected to modified atmosphere packaging using different ratios of carbon dioxide and nitrogen inside the packets (Plate-A). PA/PE co-laminates were used for the modified atmosphere packaging of paneer cubes. Approximately 100g of paneer was packed in each packet. Fifteen packets for each gas composition were prepared and stored for shelf life study at 5±1^{0}C and 30±1^{0}C. The gas composition used for storage study was as follows: (Table A)

Table A. Gas composition used for MAP of paneer cubes

Sample code	Air, %	CO_2, %	N_2, %
C_1	0	10	90
C_2	0	30	70
C_3	0	50	50
C_4	0	70	30
Control	100	0	0

Plate A : Showing coated paneer sample packaged in PA/PE extrusion laminated pouch under modified atmospheric condition

Frying of paneer :

Frying of paneer cubes was done in refined soybean oil at a temperature of 170±5°C for 20±1 sec till the surface of cubes attained a golden brown colour (Plate-B). The temperature was kept constant for all the batches throughout the experiment. Excessive browning of surface was avoided.

Storage :

Test samples and control samples were stored at 5±1^{0}C and 30±1^{0}C. Test samples stored at 5±1^{0}C were withdrawn at an interval of 21 days for analysis upto 42 days, then after 10

days interval till samples get spoiled and those stored at 30±1^{0}C were analyzed at an interval of 2 days till the samples were spoiled and became unfit for human consumption. For control sample, uncoated paneer cubes were packed in the PA/PE co-laminated packets under the normal atmospheric condition. Control samples stored at 5±1^{0}C and 30±1^{0}C were withdrawn at an interval of 4 days and 2 days, respectively.

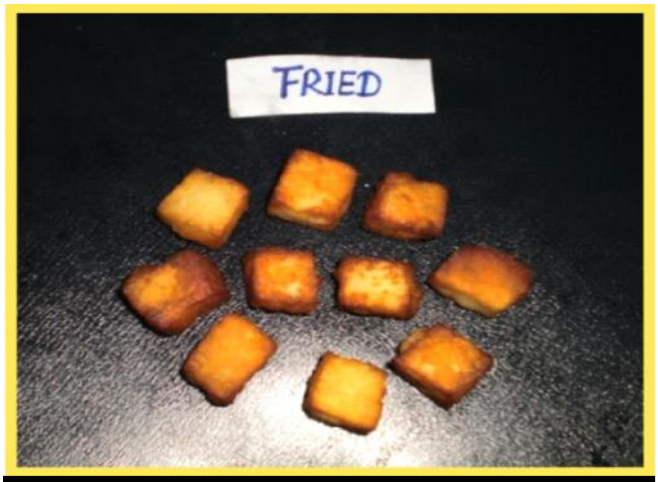

Plate B: Showing fried paneer sample

Analysis :

Hardness of fried paneer cubes was determined using the texture analyzer (TA-XT2i, Stable Micro Systems, UK) having specifications: load cell capacity- 25 kg, test speed- 5 mm/sec, post test speed- 10 mm/sec, trigger-force- 5 g. A circular compression platen (probe, P-75) made of stainless steel was used for measuring the hardness of paneer samples throughout the study.

The data were interpreted statistically using ANOVA-two way classification technique as described by Snedecor and Cochran (1968). The results were analyzed at 1% level of significance.

OBSERVATIONS AND ASSESSMENT

Data presented in Table 1 and 2 show changes in hardness of fried control and test paneer samples, respectively due to storage at 5±1°C and 30±1°C. Data revealed that hardness of control paneer samples increased during the early days of storage and then decreased during the later days of storage period of 16 days at 5±1°C and 6 days at 30±1°C (Fig. 1 and 2). The overall increase in hardness was 8.41% at 5±1°C and 18.01% at 30±1°C. The maximum values of hardness for control samples stored at 5±1°C and 30±1°C were observed on 12th day (7127.43g) and 4th day (9058.16g) of storage, respectively. The initial increase in the hardness may be due to development of crumbly texture in the raw paneer which on frying becomes harder. The decrease in the hardness may, however, be due to microbial proliferation in paneer samples leading to softening of texture on storage.

The changes in hardness of the test paneer samples stored at 5±1°C after subjecting them to frying showed an increasing trend during the entire storage period of 82 days. This may be due to more moisture loss from paneer cubes which probably led to firmer texture on frying. The increase in hardness ranged

Table 1. Changes in hardness* of control paneer sample during storage

Storage period in number of days at 5±1°C					Storage period in number of days at 30±1°C			
0	4	8	12	16	0	2	4	6
5873.03	6630.59	7863.54	7127.43	6367.29	6127.31	8033.51	9058.16	7231.33

Average value of triplicate experiments Control= Uncoated paneer cubes packed under atmospheric conditions

Table 2. Changes in hardness* of test paneer samples during storage

Sample code	Storage period in number of days at 5±1°C							Storage period in number of days at 30±1°C				
	0	21	42	52	62	72	82	0	2	4	6	8
C1	5715.61	5845.55	5643.88	8324.88	8665.06	8175.06	8487.72	6061.957	6950.32	7764.35	8148.74	7739.72
C2	5678.98	5688.91	6311.76	8655.34	8430.08	9234.56	9634.76	6311.483	6554.23	7315.97	7386.56	7332.22
C3	6234.76	6450.016	5444.87	8993.12	8443.85	9098.99	9398.89	5420.48	6338.484	6719.41	7903.37	5809.99
C4	7654.99	5046.21	8766.98	8944.91	8997.82	9622.34	9922.56	6165.54	7549.17	7678.29	9485.26	8164.74

C1=10%CO_2/90%N_2, C2=30%CO_2/70%N_2, C3=50% CO_2/50% N_2, C4=70%CO_2/30%N *Average value of triplicate experimen

Table 3. Effect of coating and MAP on hardnessof fried test paneer samples during storage at 5±1and 30±1°C

Statistical parameter	Values at 5±1°C			Values at 30±1°C		
	a	b	a*b	a	b	a*b
F value	2.628 *	1.461 NS	1.089 NS	2.089 NS	0.756 NS	0.959 NS
SEM	9182.889	6941.611	18365.78	2314.402	1749.523	4628.804
C.D. (P=0.01)	34631.02	26178.59	69262.04	8728.2	6597.899	17456.4

* indicates significance of value at P=0.05, NS=Non-significant a= Effect of coating; b=Effect of MAP

between 29.62 to 69.65% and was maximum for C2 when stored at 5±1°C (Fig. 1). Similar trend was also observed with the test samples stored at 30±1°C but on the last day of storage (8th day) hardness showed a sudden decrease which might be due to microbial growth resulting in soft texture (Fig. 2). Data showed that there was a significant variations in the hardness of fried paneer samples with respect to duration of storage**.** However, on comparing the values of hardness of control and test samples it can be observed that coating and MAP did not significantly (P=0.01) modify the texture of fried paneer (Table 3, Annexure). Similar results were also obtained by Rayner *et al.* (2000) during working on deep-fat fried potato discs coated with plasticized soy protein films. Besides, Funami *et al.* (1999) worked on doughnuts and found that methylcellulose addition had no effect on breaking stress of the samples.

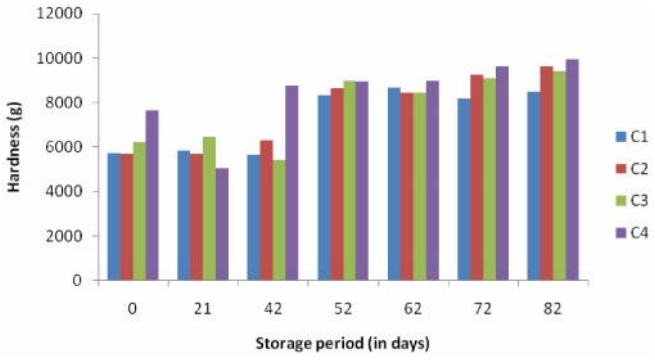

Fig. 1. Hardness of fried paneer samples stored at 5±1°C

Conclusion :

The present investigation revealed that the combination of edible coating and MAP did not significantly (P=0.01) affect the hardness of fried paneer cubes at both the storage temperatures of 5±1°C and 30±1°C. Hence, this combination can become a promising method of preserving paneer without effecting its textural properties while processing.

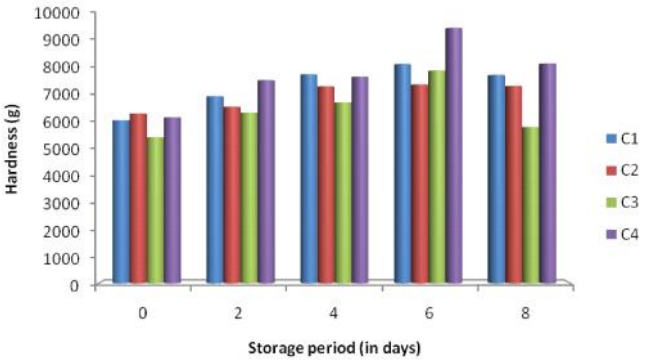

Fig. 2. Hardness of fried paneer samples stored at 30±1°C

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