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Correlations among sensory, textural and chemical parameters of paneer (Indian soft cheese)

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Abstract
Paneer is is prepared by the heat and acid coagulation process of cow or buffalo milk. However, the quality of *paneer* mainly depends upon the quality of milk, heat treatment, moisture content in *paneer*, and storage condition. Therefore, in the present study, correlations were studied among sensory, physic-chemical, textural, and microbiological parameters of *paneer* samples. There have been noted some good correlations like: body and texture (BT) score versus fat content (r = 0.879), flavor score versus body and texture score (r= 0.931), overall acceptance score versus body and texture score (r =0.974), overall acceptance score versus flavor score (r= 0.947) and chewiness verses gumminess (r= 0.932).

Keywords: Sensory properties, Chemical and textural properties, Correlations

Introduction
Paneer is an important traditional indigenous milk product, which is prepared by the heat and acid coagulation process of milk (Chitranayak *et al.* 2017) [15]. Food safety & Standard Authority of India 2006 defined *paneer* as a product obtained from cow or buffalo milk or a combination thereof by precipitation with sour milk, lactic acid, or citric acid (Wangdare, Rao, Mishra & Datir, 2017) [36]. Moisture content shall not be more than 70.0 percent, and milk fat content shall not be less than 50.0 percent of the dry matter (Wangdare *et al* 2017) [36]. *Paneer* has great importance in a daily meal for the preparation of a variety of culinary dishes and snacks due to rich in quality proteins, fat, minerals as well as vitamins, which helps in fulfillment of basic nutritional demands of consumer (Desale, Dhole, Deshmukh & Nimase, 2009; Goyal, Singh & Goyal, 2007; Khan & Pal, 2011) [17, 23, 27]. Chemical composition of *paneer* consists of 40 percent total solids, which include 25 percent fat, 17.5 percent proteins, 2 percent carbohydrates, and 1.5 percent minerals, which is one of the major sources of vegetarian consumers (Sachdeva, 1998). The main quality attributes of *paneer* that should be a uniform with the pleasing white appearance and a greenish tinge when prepared from buffalo milk and light yellow when prepared from cow milk. Moreover, quality attributes include mildly acidic flavor with a slightly sweet taste and a soft, cohesive, and compact texture (Kumar, Rai, Niranjan & Bhat, 2014) [28]. It has stated that nearly about 4-5% of the total milk produced, which converted into *paneer* in India (Chandan, 2007) [14]. *Paneer* has a short storage life of about 5-7 days at refrigeration storage with limited deterioration in the quality. However, the freshness of the *paneer* lost after 3 days (Dhankhar, 2014) [18]. Furthermore, another study observed that the quality of *paneer* was not uniform, which mainly depends upon the quality of milk, heat treatment, the moisture content in *paneer*, and storage condition (Agarwal & Das, 2001; Masud, Shehla & Khurram, 2007; Das & Ghatak, 1999) [2, 29, 16]. Many researchers studied relationships between subjective and objective responses, for example between textural properties and sensory acceptance (Meullenet, Lyon, Carpenter & Lyon, 1998; Skriver, Holstborg & Qvist, 1999; Drake, Gerard, Truong & Daubert, 1999) [30, 32, 20], chemical characteristics and sensory properties (Casiraghi, Lucisano & Pompei, 1989; Janhøj, Petersen, Frøst & Ipsen, 2006) [25] and total solids and viscosity (Fernandez-Martin, 1972) [22]. Establishing a mathematical relationship provides us explanations about product

characteristics. However, very few studies carried on the relation between physicochemical, sensory, textural, and microbiological quality of *paneer*. In the present study, a total of 8 brands have been analyzed, including self-prepared and each brand with 10 packets for their physicochemical, textural, sensory, and microbial quality. Correlations were studied among sensory, physic-chemical, textural, and microbiological parameters of *paneer* samples.

Materials and methods

Collection of *paneer* samples

The objective was to collect *paneer* samples from the Bengaluru market. Initially, the shops where *paneer* was being sold in Bengaluru city were surveyed for their locations. Based on the information, the shops were selected randomly for a collection of *paneer* samples. A total of 80 samples of *paneer* from different shops were collected and brought to the laboratory in an icebox container. Care was taken to collect packets within the use-before-date.

Chemical analysis

Moisture content in *paneer* was determined, according to BIS (1983) [10]. The fat content of *paneer* was determined by the method described for cheese, according to BIS (1977) [9]. Total nitrogen or total protein in *paneer* was determined as per the method described in AOAC (2005) [5] with modification. Lactose/sugar was derived by a difference in the total of the major constituents like moisture, protein, fat, and ash from 100, as described by AOAC (1990) [4]. The ash content of *paneer* was estimated by the method of AOAC (2005) [5]. The pH of *paneer* was measured as described by Awad, Hassan & Halaweish. (2005) [6]. Titratable acidity in *paneer* was determined by titration method BIS (1983) [10].

Evaluation of *paneer* for sensory attributes

Sensory attributes play a major role in determining the acceptability of a food product as well as the ultimate purchase decision of consumers (Baig *et al.* 2019) [7]. The evaluation was carried out room temperature under proper lighting. Each block of refrigerated *paneer* samples was cut into rectangular cubes of approximately 2cm × 2cm, tempered to room temperature and served to panel of semi-trained judges (minimum of six members, of which four were males and two females; two from age group 25 to 30 years, two from 30 to 40 years and two from above 50 years) for evaluation of sensory attributes like color and appearance, body and texture, flavor and overall acceptability on a 9-point hedonic scale (Peryam and Pilgrim 1957; Borrin *et al*. 2018; Vital *et al*. 2018) [31, 11, 33]. The sensory panel was drawn from faculty and post-graduate students of the Institute. The panel members were chosen based on their aptitude, willingness to spare time, and availability for sensory evaluation. Further, all the chosen panel members were regular consumers of *paneer* and are well acquainted with the quality and defects of *paneer*. Hence, variation in the sensory evaluation among the panelists was minimal.

Colour characteristics

The Colour of the *paneer* samples was measured by Scanner-Adobe Photoshop (SAP) method (Vyawahare and Rao, 2012) [34].

Instrumental textural characteristics

Texture profile analysis (TPA) parameters, viz. hardness, cohesiveness, springiness, and chewiness were determined using the Stable Microsystems (Godalming, UK) TA-XT plus Stable Micro System Texture Analyzer (UK) by two-bite linear compression (Dwarakanath *et al*. 2013) [21]. A circular disc probe 75 mm (P/75) diameter was attached to the cross-head of the machine. The instrument test settings of TA.XT plus instrument were as follows: option: return to start; test mode: compression; pre-test speed: 1 mm/sec; test speed: 5 mm/sec; post-test speed: 5 mm/sec; target mode: distance; distance: 10 mm; time: 5 sec; trigger type: auto (Force); trigger force: 2 g; break mode: off; advanced option: on; probe: P/75 plunger probe. The probe was calibrated to a distance of 50 mm, from the base of the platform. The *paneer* samples were cut into 20 × 20 × 20 mm cubes and were tempered to 25 °C in a temperature-controlled cabinet for 1–2 h and the tests were carried out at the same temperature. The probe was positioned centrally over the sample surface and allowed to compress the product. The probe traveled to a distance of 10 mm, compressing the product by 50% of its height and returned to the original position (1st bite); after a time gap of 5 sec, the probe again compressed the sample and returned to the original position (2nd bite), generating a force-time curve. The texture profile parameters were determined from the force-time curve as given by Dwarakanath *et al*. (2013) [21]

Correlation analysis

Pearson's correlation coefficient (r), which is a measure of the strength of the association among physic-chemical, textural, microbiological, and sensory scores, was first computed (Akoglu, 2018) using SPSS software. Physico-chemical parameters included: pH, acidity, moisture, fat, protein, ash, lactose, L, a, b (color parameters); textural parameters included: adhesiveness, cohesiveness, hardness, springiness, gumminess, chewiness, resilience; microbiological parameters: Total bacterial count (TBC) and yeast and mold count (YMC); sensory parameters: color and appearance, flavor, body and texture and overall acceptance scores. From among the above relationships, only those who showed an r-value of above 0.70 were considered for further regression analysis. The goodness of fit was evaluated by R2 as well as Root mean square (RMS) value. The R-squared value means that its product with 100 indicates the percent variation that can be explained by the variable under consideration. The intercept in a multiple regression model is the mean for the response when all of the explanatory variables take on the value 0. The regression coefficient of a variable is interpreted as the change in the response based on a 1-unit change in the corresponding explanatory variable keeping all other variables held constant. The models exhibiting R2 values more than 0.70 were considered as best fit models. The goodness of fit was further evaluated by computing RMS values and residual plots between the experimental and predicted values. The lower the RMS value, the better was the goodness of fit. RMS value of less than 10.0 was considered as a good fit (Akoglu, 2018). Linear regressions were carried out between sensory score and chemical parameters using the SPSS package. Relationships between subjective and objective responses were studied by many researchers, for example between textural properties and sensory acceptance (Meullenet *et al*. 1998; Skriver *et al*. 1999; Drake *et al*. 1999) [30, 32, 20] chemical characteristics and sensory properties (Casiraghi *et al*. 1989; Janhoj *et al*. 2006) [13, 25], and total solids and viscosity (Fernandez-Martin, 1972) [22]. Establishing a mathematical relationship provides us explanations about product characteristics and helps in the

holistic evaluation of products' quality. Few research papers are available describing the comparison of sensory and textural analysis of semisolid food products.

Statistical analysis

The data collected were arranged in a completely randomized design and analyzed by one ANOVA technique using SPSS software. Post Hoc tests of Tukey were carried out to determine the significant difference between any two brands of *paneer*. Regressions were carried out between sensory score and chemical parameters using the SPSS package.

Results and discussion

Pearson correlations among sensory, textural and chemical characteristics of *paneer*

The data of sensory scores, chemical parameters, instrumentally measured textural parameters, and microbial parameters were correlated with each other. Pearson's r values indicated that many correlations were not satisfactory (r <0.70). Only correlations with r2 with more than 0.70 are given in Table 1. In this correlation study, it was observed that some correlations were found satisfactory, and some were excellent. Very good correlations included body and texture score versus fat content (r = 0.879), flavor score versus body and texture score (r= 0.931), overall acceptance score versus body and texture score (r =0.974), overall acceptance score versus flavor score (r= 0.947) and chewiness verses gumminess (r= 0.932) (Table 1) and rest of sensory, textural and chemical parameters showed satisfactory correlations (Table 1). These observations show the possibility of regressions between the data, which showed satisfactory Pearson's correlations. Hence, the various data were subjected to univariate and multiple linear regression analyses.

Table 1: Pearson correlations* among sensory, textural and chemical characteristics of paneer collected from Bengaluru market

S. No.	Correlation between	r
1	Color and appearance score – Moisture %	0.720
2	Body and texture score – Moisture %	0.794
3	Body and texture score – Fat %	0.879
4	Flavour score – Fat %	0.812
5	Overall acceptance score – Moisture %	0.770
6	Overall acceptance score – Fat %	0.774
7	Flavour score – Color and appearance score	0.729
8	Flavour score – Body and texture score	0.931
9	Overall acceptance score - Color and appearance score	0.774
10	Overall acceptance score – Body and texture score	0.974
11	Overall acceptance score – Flavour score	0.947
12	Color and appearance score- Body and texture score	0.764
13	Fat content – Moisture %	0.894
14	Gumminess – Hardness	0.875
15	Chewiness – Hardness	0.800
16	Chewiness – Gumminess	0.932

Note: All the correlations are significant at $p<0.05$; * r values more than 0.70 are given

Regression between sensory score and chemical parameters

When color and appearance (CA) score was regressed with moisture %, the regression was found to be reduced (R2 = 0.46), indicating that the CA score was not dependent on the moisture content of *paneer*. However, when fat% also was included in the regression, the R2 value increased to 0.50, showing some contribution of fat content to the CA score. Thus it was observed that as protein, lactose, ash, and acidity were included in regression analysis, the R2 gradually increased, indicating that all these parameters did contribute to the CA score. Yet, the regression was not satisfactory based on the final R2 value of 0.57 (well below 0.70) (Table 2). These observations indicate that the CA of *paneer* is not much influenced by chemical composition.

Body and texture (BT) scores have an R2 value of 0.61, which was not satisfactory. However, BT has a satisfactory relation with fat content (R2 0.75). However, when more chemical parameters are added to regression, the R2 value remained the same or decreased to 0.73. This indicates that the BT score is the primary function of fat content and not any other chemical parameter studied. R2 between flavor score and fat content was 0.61, which was not satisfactory though statistically significant. When all the chemical parameters are included in the regression, the R2 value rose to 0.71, which indicates that the flavor score is influenced not only by fat content but also on moisture, protein, mineral, and acidity (Table 2). The R2 between Overall acceptability (OA) score and moisture was 0.75, which indicates a satisfactory relationship. However, R2 remained the same, even when other chemical parameters were added to regression (Table 2). This indicates that the overall acceptance of *paneer* is mainly dependent on the moisture content. Khamrui, Dutta & Dave (2004) [26] reported that sensory textural parameters exhibited significant correlations with instrumental measurements; the former was more efficient in registering changes in brittleness and stickiness attributes. It was also a known fact that low-fat *paneer* has the limitations of textural attributes.

Table 2: Regressions between sensory score and chemical parameters

S. No.	Regression between	R^2 value
1	Color and appearance score – Moisture %	0.46
2	Color and appearance score – Moisture% +Fat%	0.50
3	Color and appearance score – Moisture% +Fat%+ Protein%	0.51
4	Color and appearance score – Moisture %+Fat%+ Protein%+ Lactose%	0.54
5	Color and appearance score – Moisture% +Fat%+ Protein%+ Lactose%+ Minerals%	053

6	Color and appearance score – Moisture %+Fat %+Protein% +Lactose %+Minerals% +Acidity%	0.57
7	Body and texture score – Moisture %	0.61
8	Body and texture score – Fat%	0.75
9	Body and texture score – Moisture% +Fat%	0.74
10	Body and texture score – Moisture% +Fat% +Protein%	0.74
11	Body and texture score – Moisture% + Fat%+ Protein% +Lactose%	0.73
12	Body and texture score – Moisture% +Fat% +Protein% +Lactose% +Minerals%	0.73
13	Body and texture score – Moisture% +Fat %+Protein% +Lactose% +Minerals% + Acidity%	0.73
14	Flavour score - Fat%	0.65
15	Flavour score – Moisture% + Fat%	0.64
16	Flavour score – Moisture %+Fat% +Protein%	0.67
17	Flavour score – Moisture% +Fat %+Protein% +Lactose%	0.69
18	Flavour score – Moisture %+Fat%+ Protein% +Lactose %+Minerals%	0.68
19	Flavour score – Moisture %+Fat% +Protein% +Lactose% +Minerals% +Acidity%	0.71
20	Overall acceptance score- Moisture%	0.75
21	Overall acceptance score- Moisture% + Fat%	0.75
22	Overall acceptance score – Moisture %+Fat %+Protein%	0.75
23	Overall acceptance score – Moisture %+Fat% +Protein% +Lactose%	0.75
24	Overall acceptance score – Moisture %+Fat% +Protein% +Lactose%+Minerals%	0.75
25	Overall acceptance score – Moisture% +Fat% +Protein% +Lactose% + Minerals%+ Acidity%	0.75

Note: All the regressions are significant at $p<0.05$; * R^2 values more than 0.70 are given

Regression between chemical parameters

The chemical constituents of *paneer* include moisture, fat, protein, ash, and lactose contents. Their contents may be interdependent on each other. For example, fat content is dependent on Moisture content (R2 = 0.68); however, the higher R2 value of 0.88 indicates that the fat content is dependent on moisture, protein, and lactose put together (Table 3).

Table 3: Regressions between chemical parameters

S. No.	Regression between	R^2
1	Fat - Moisture%	0.68
2	Fat – Moisture% + Protein%	0.71
3	Fat – Moisture% + Protein% + Lactose%	0.88

Note: All the regressions are significant at p<0.05; *R^2 values more than 0.70 are given

Regression between sensory parameters

Table 4: Regressions between sensory parameters

S. No.	Regression between	R^2
1	Flavour score – Color and appearance score	0.65
2	Flavour score - Body and texture score	0.85
3	Overall acceptance score - Color and appearance score	0.66
4	Overall acceptance score – Body and texture score	0.93
5	Overall acceptance score- Color and appearance score +Flavour score	0.66
6	Overall acceptance score- Color and appearance score +Body and texture score	0.94
7	Overall acceptance score- Flavour score +Body and texture score	0.94
8	Overall acceptance score- Color and appearance score +Flavour score+ Body and texture score	0.95

Note: All the regressions are significant at $p<0.05$; * R^2 values more than 0.70 are given

Flavour score and CA have R2 of 0.65, which indicates flavor is influenced to a certain extent by color and appearance. That means the right color and appearance might influence the consumer for better acceptance of flavor. However, the flavor score is significantly influenced by (body and texture) BT score. This means if BT is good, most probably flavor also be evaluated as useful. Psychologically, the consumer may be influenced by good appearance and BT. The overall acceptance score is mainly influenced by BT, as observed from R2 of 0.93. If CA and flavor are included in the regression, the R2 only rose to 0.94 (Table 4). This underlines the importance of BT in determining the sensory acceptance of *paneer* samples. Probably this observation suggests that in the 100 point scorecard of *paneer*, maximum marks should be allotted to BT rather than flavor. Thus, OA is not determined by CA and flavor score alone, but highly dependent on BT score in combination with CA and flavor. OA is decided by CA, flavor, and BT of *paneer* (Table 4).

Regression between TPA parameters

Regression analyses also showed some good relationships among TPA parameters. For example, gumminess Vs Hardness + Cohesiveness (R2 = 0.96) and chewiness Vs Springiness + gumminess (R2 = 0.92) showed R2 values higher than 0.90. The rest of the TPA parameter showed satisfactory regression (Table 5). TPA parameters are interdependent. This is obvious because some of them are mathematically derived from other TPA parameters. For instance, Gumminess = Hardness x Cohesiveness; Chewiness = Hardness x Springiness x Cohesiveness (Bourne, 2002) [12].

Table 5: Regressions between TPA parameters

S. No.	Regression between	R^2
1	Gumminess – Hardness	0.77
2	Gumminess – Hardness + Cohesiveness	0.96
3	Chewiness – Hardness	0.65
4	Chewiness – Hardness + Cohesiveness	0.80
5	Chewiness – Hardness + Cohesiveness+ Springiness	0.86
6	Chewiness – Gumminess	0.87
7	Chewiness – Springiness + Gumminess	0.92

Note: All the regressions are significant at $p<0.05$; * R^2 values more than 0.70 are given

Best fit relations

From among the relationships studied, the best ones are discussed. Chemical parameters influence the sensory score; however, no sensory score was influenced by one chemical parameter alone except fat content, which alone influenced

the BT score (R2 0.75). A combination of chemical parameters influenced the sensory scores. For example, the flavor is a function of all the compositional parameters that indicate that the flavor of *paneer* is a complex phenomenon determined by several parameters (Table 6). However, among the chemical parameters, fat content and acidity have the most influence, as indicated by higher regression coefficients (0.1043 and 0.7516) (Table 6). Flavour score was influenced by BT (R2 0.85), which means if BT is right, then most probably flavor is also perceived to be good. Whereas OA is dependent on all the sensory attributes CA, BT, and Flavour. It was further observed that fat content is dependent on moisture, protein, and lactose contents (Table 6). Di Monaco, Cavella & Masi (1995) reported that sensory attribute aroma and flavor descriptors correlated with organic acid concentrations and sensory parameter best correlated with the TPA parameter. Khamrui *et al*. (2004) [26] reported that sensory textural parameters exhibited significant correlations with instrumental measurements. Yamul, Galmarini, Lupano & Zamora (2013) [35] reported that good correlation was obtained between the instrumental and sensory attributes hardness, cohesiveness, and elasticity. But, surprisingly, in the present study, no good correlation was obtained between sensory scores and instrumentally determined textural attributes. There was no relationship between sensory score and instrumentally measured color parameters as well as microbial counts also. These observations indicate that wide variations exist in instrumentally measured textural attributes, instrumentally measured color attributes, and microbial counts, whereas variations were least in sensory scores. This is the possible reason for no functional correlations were existing among the sensory and textural parameters. Moreover, judges were not insistent upon any specific quality on which sensory score can be varied. This is more so because in this study 9-point Hedonic scale was used rather than a 100 point scorecard. The hedonic scale is indicative of only a 'liking level' than any critical evaluation. This could be the reason for many weak correlations among the data of the present study.

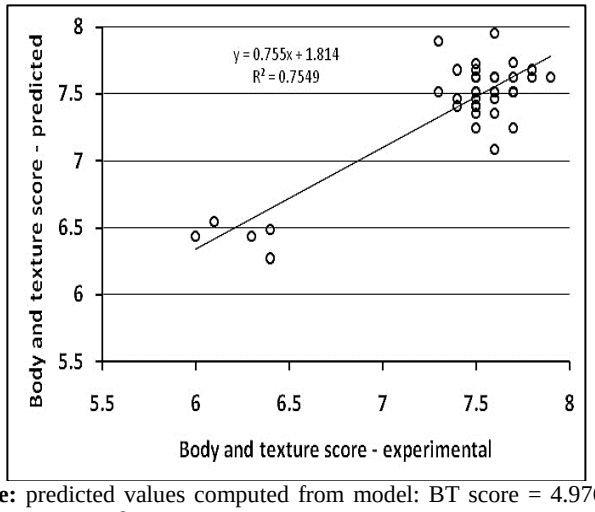
Residual plots

Residual plots between predicted values using best fit models (Table 6) and experimental values were generated and the trend observed. The goodness of fit was also shown by RMS values. The residual plots of BT scores predicted from fat content, flavor score predicted from moisture +fat +protein +lactose +ash +Acidity values, flavor score predicted from fat%, and OA score predicted from CA +Flavour +BT scores are portrayed in Fig. 1, 2, 3, and 4, respectively. It may be seen from the plots that the R2 values lay more than 0.75, and RMS values were between 1.29–5.73. This indicates that the above relationships do follow a mathematical pattern and can be predicted from each other satisfactorily. For example, we can predict BT acceptance based on fat content. We can predict flavor acceptance from chemical composition and acidity. We can predict flavor acceptance from BT, which means if BT is good, most probably flavor is also good. Not only can a judge score OA himself, but also it is possible to predict the OA score from CA, flavor, and BT scores.

Table 6: Best fit relations

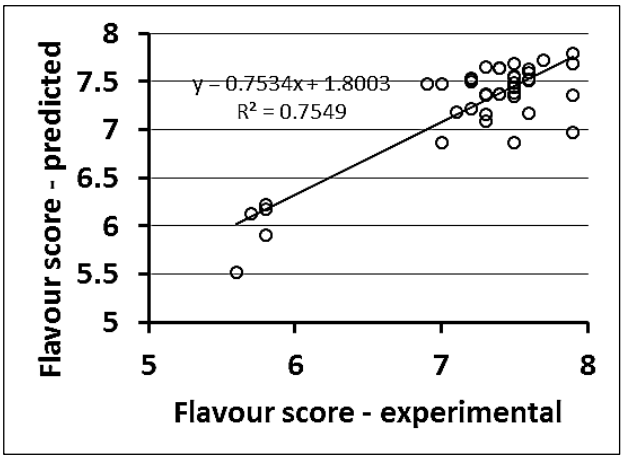
S. No.	Regression between	b0	b1	b2	b3	b4	b5	b6	Adj R^2	RMS
1	Body and texture score - Fat%	4.976	0.1082	-	-	-	-	-	0.75	3.18
2	Flavour score – Moisture %+Fat %+Protein %+Lactose %+Minerals%+ Acidity%	6.033	-0.010	0.1043	0.00467	-0.0723	-0.01253	-0.7516	0.71	4.23
3	Flavour score – Body and texture score	-1.782	1.2168	-	-	-	-	-	0.85	3.43
4	Overall acceptance score – Color and appearance + Flavour +Body and texture score	0.466	0.1363	0.1679	0.6292	-	-	-	0.95	1.29
5	Fat – Moisture% + Protein %+Lactose%	83.753	-0/8727	-0.60	-0.8365	-	-	-	0.88	5.73

Note: b0, b1, b2, b3, b4, b5, b6 – regression coefficients; All the regressions are significant at $p<0.05$;



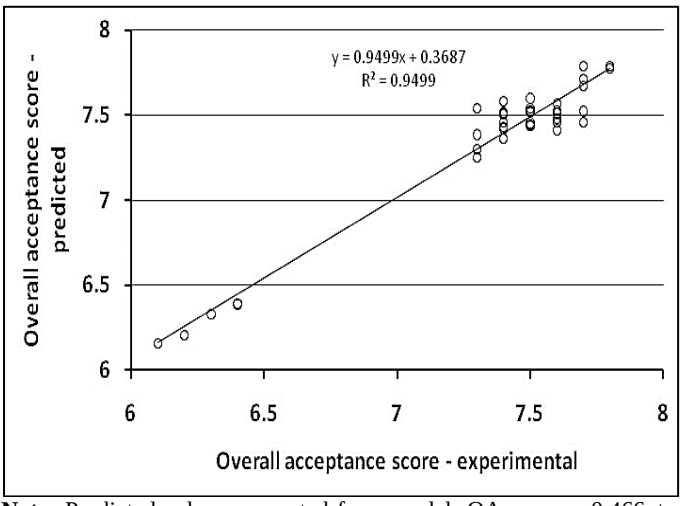
Note: predicted values computed from model: BT score = 4.976 + 0.1082. Fat% (R^2 = 0.75)

Fig. 1: Residual plot of experimental body and texture scores and predicted body and texture scores



Note: predicted values computed from model: Flavour score = 6.033 – 0.010.Moisture% + 0.1043. Fat% + 0.00467. Protein% - 0.0723. Lactose% - 0.01253. Ash% - 0.7516. Acidity% (R^2 0.71)

Fig. 2: Residual plot of experimental flavor scores and predicted flavor scores

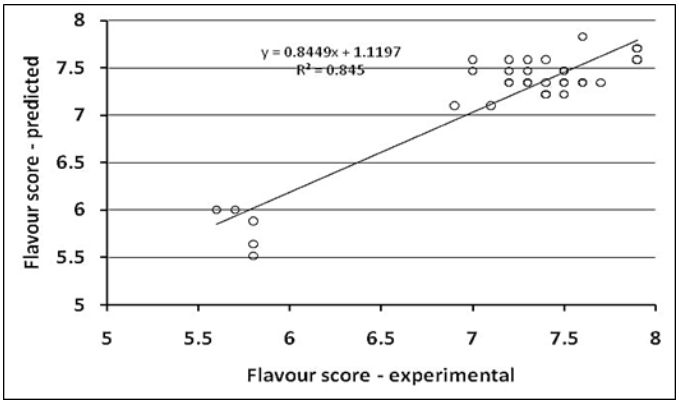


Note: Predicted values computed from model: OA score = 0.466 + 0.1363.CA score + 0.1679. Flavour score + 0.6292. BT score (R^2 0.95)

Fig 4: Residual plot for experimental overall acceptance score and predicted overall acceptance score

3.8 Characteristics of best quality *paneer*

The *paneer* samples collected exhibited variations in the acceptance scores, especially overall acceptance scores. Based on the tabular analysis, the characteristics of all those *paneer* samples, which were scored higher than 7.5 (which was arbitrarily taken as a cut-off score for best acceptance of *paneer*), have been tabulated in Table 7. Among all these parameters, notable ones are those of moisture content varying from 49.52-58.87% and fat% varying from 21–25.4%. The low fat *paneer* resulted in lower acceptance scores. However, the values of parameters given in Table 7 are only indicative and suggestive and statistically derived ones because weak correlations observed in the study.



Note: predicted values computed from model: Flavour score = -1.782 + 1.2168.Fat% (R^2 0.85)

Fig 3: Residual plot of experimental flavor scores and predicted flavor scores

Conclusion

Correlations were studied among sensory, physic-chemical, textural, and microbiological parameters of *paneer* samples. Most of these showed poor correlations, r value being less than 0.70. However, some good correlations were noted like: body and texture score versus fat content (r = 0.879), flavor score versus body and texture score (r= 0.931), overall acceptance score versus body and texture score (r =0.974), overall acceptance score versus flavor score (r= 0.947) and chewiness verses gumminess (r= 0.932). Regression analyses indicated a good fit for some univariate and multiple linear models. The univariate model was the best fit for BT score Vs. Fat%; Flavour score Vs. BT score; Multiple linear models were best fit for Flavour score Vs. Moisture %+Fat %+Protein %+Lactose %+Minerals% + Acidity%; Overall acceptance score Vs. Color and appearance + Flavour +Body and texture score. This indicates that the above relationships do follow a mathematical pattern and can be predicted from each other satisfactorily. For example, we can predict BT acceptance based on fat content. We can predict flavor acceptance from chemical composition and acidity. We can predict flavor acceptance from BT, which means if BT is good, most probably flavor is also good. Not only can a judge score OA himself, but also it is possible to predict the OA score from CA, flavor, and BT scores.

Table 7: Characteristics of most accepted paneer samples

S. No.	Parameter	Overall acceptance score between 7.5-7.8
1	Colour parameters: a	124.03 - 126.86
2	b	137.83 - 158.25
3	pH	5.1 - 6.29
4	Textural parameters: Hardness, N	21.01 - 58.08
5	Adhesiveness, N.sec	0.05 - 0.96
6	Cohesiveness	0.38 - 0.71
7	Springiness	0.31 - 0.98
8	Gumminess, N	11.29 -35.76
9	Chewiness, N	9.04 - 24.05
10	Chemical parameters: Resilience	2.93 - 7.84
11	Moisture%	49.52 - 58.87
12	Fat%	21 - 25.4
13	Protein%	15.53 -24.08
14	Lactose%	0.09 - 6.87
15	Ash%	1.46 - 1.96
16	Acidity% LA	0.31 - 0.90
17	Microbiological parameters: TBC, per g	10.5-43.5
18	YMC, per g	7.5 - 24

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