

Evaluation of Chemical, Physical, Microbial and Sensory Properties of Garlic Butter by Using Cow Milk

Wadiwela Mudiyanseelage Sumithra Nayanangani, Mylvaganam Pagthinathan and Suneth Gunathilaka

ABSTRACT

Butter is a popular dairy product composed of mainly milk fat and other minor components such as water, vitamins, enzymes, and minerals which are beneficial for health. The study was to investigate the effect of garlic (*Allium sativum*) powder addition on the chemical, physical, microbial, and sensory properties of butter, incorporated with garlic at the rate of 2% garlic chips and 2% garlic powder (w/w) and 2% garlic chips and 4% garlic powder (w/w). Butter samples were analyzed for physical, chemical, microbial and sensory properties during refrigerated storage at 7 °C. The physico-chemical and sensory characteristics were analyzed during storage. Moisture, total solids, fat, free fatty acids, titratable acidity, and pH were significantly different ($p < 0.05$) among the treatments on day one. The results of this study revealed that the moisture ($14.09 \pm 0.10\%$) and total solids ($85.91 \pm 0.10\%$) content were significantly ($p < 0.05$) higher in butter without incorporating garlic chips and powder. Fat content ($80 \pm 0.00\%$) was significantly ($p < 0.05$) lowest in butter incorporated with 2% garlic chips and 4% garlic powder. While free fatty acids were significantly ($p < 0.05$) highest in butter incorporated with 2% garlic chips and 4% garlic powder and lowest in butter without added garlic chips and powder. pH ($6.09 \pm 0.03\%$) was significantly ($p < 0.05$) lowest in butter incorporated with 2% garlic chips and 4% garlic powder. Titratable acidity ($0.13 \pm 0.02\%$) was significantly ($p < 0.05$) lower in butter without added garlic chips and powder. 2% garlic chips and 4% garlic powder added to butter showed the highest (48.75 ± 1.18 Mm/g) antioxidant activity. During storage, the pH value was significantly ($p < 0.05$) decreased and titratable acidity was increasing with the storage period. The cohesiveness, gumminess and springiness were significantly ($p < 0.05$) increased. Organoleptic characteristics revealed that 2% garlic chips and 4% garlic powder added to butter had the highest mean score of overall quality of all sensorial properties. Finally, most of the panelist accepted, that butter is made from 2% garlic chips and 4% garlic powder than other types of butter.

Keywords: Butter, garlic, sensory properties, storage.

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I. INTRODUCTION

Butter is consumed worldwide because it can be considered as a commercially available main dairy product. Butter is a major portion of the nutritive value of milk [1]. Generally, in the dairy industry, butter is a valuable product among milk fat-based outputs. Their taste, textural characteristics, and nutritional value have affected the demand for butter [2]. Butter is a very interesting and famous food used by the people all over the world and it is very important in human nutrition, and it consisted of high fat and high energy source of food, and minerals and fat-soluble vitamins like vitamin K, A, D, E [3]. The energy and essential fatty acids are provided by butter, butter oil and ghee [4]. Water content and fat content are the main quality parameters of butter.

The butter should have contained at least 80% of milk fat, 16% of water and 2% of non-fat milk components. Vegetable fat and milk fat can be used in butter manufacturing process, and it caused to enhance the taste [3]. Butter undergoes oxidative degradation (rancidity) of fat during storage, resulting in an alteration of major quality

parameters such as flavour, nutritive value, colour and aroma which reduce the shelf life of the butter [5]. Garlic is the most valuable medicine which is very useful for human beings. It has minerals, vitamins, and other useful components to improve the health of humans [6]. Garlic can be used to cure many diseases like high blood pressure, cholesterol [7], cancer, wound healing [8], cold, cough, asthma, arthritis [9], backache, bronchitis, antioxidant chronic fever [10], tuberculosis, malaria, rhinitis, obstinate skin disease, discolouration of the skin, leprosy, leucoderma, itches [7], piles, fracture of bone, fistula, gout, urinary diseases, diabetes, kidney stone, anaemia [6], cataract and night blindness [10]. Garlic has the potential of an antioxidant. Which is it most important to delay the lipid oxidation [11]. According to the many recent clinical studies, the daily intake of dehydrated garlic powder has been ~900 mg, and aged garlic extract intakes range from 1 to 7.2 g for good human health [12]. Garlic is used as a spice in the food industry types of both fresh and dehydrated state. Powders, flakes, and slices are the different types of dehydrated products of garlic in the market. Garlic has the ability to increase the taste of foods and also helps them to

digestible [6]. Garlic butter is used to enhance the flavours and aroma of the food [13]. Therefore, this study was designed to evaluate the physico-chemical and sensory properties of garlic butter produced from cow milk.

II. MATERIALS AND METHODS

A. Procedure of Garlic Chips Processing

Nearly 2×2 mm dried garlic chips were taken, and 50 g of garlic chips were soaked with 75 ml of water and kept at room temperature (25 °C) for 40 minutes. Then that the soaked garlic chips were fried with sunflower oil for 25 seconds at 65°C. After that, the fried garlic chips were removed from the additional oil in the chips.

B. Procedure for Butter Preparation

Cow milk was separated into cream and skim milk. This is done by the separator. Then the cream was entered into the butter churner, and it was churned until the fat globules coagulate and form a monolithic mass. This butter mass is washed and, salt was added to improve keeping qualities. Then the butter was produced by using different treatments of garlic powder and chips. Then it was mixed properly with spoons. The butter was packaged (80 g cup). Then a sample was stored in the refrigerator at a temperature of 7 °C for two months. The samples were analyzed on day 1, week 1, 2, 3, 4, 5, 6, and 7 of storage. The treatment was designed as such treatment 2 (T2) and treatment 3 (T3) were considered as a 2% natural garlic powder and 2% natural garlic chips fried with sunflower oil and 4% natural garlic powder and 2% natural garlic chips fried with sunflower oil, respectively. Without garlic butter was considered as control (T1).

C. Determination of Moisture, Ash and Fat Content of Garlic and Butter

The garlic powder and garlic chips samples were analysed in triplicate for moisture content using oven drying at 102°C to get a constant weight according to method AOAC [14] and percentage moisture was calculated as moisture (%) = $100 - \text{total solid (\%)}$. The moisture content of the butter samples was determined according to Shreve *et al* [15]. Two grams of each sample were dried in an oven at 105 °C for 3 h. The determination of the ash content of the samples was performed based on AOAC Official Methods 942.05 [14]. The crude fat content was determined using the Gerber method [15].

D. Determination of pH and Titratable Acidity

pH of the samples was determined using the method described Martini *et al.* [17]. A 10 g of butter was grated, and the pH of the butter sample was measured directly using a digital pH meter (model: Delta 320 pH meter) after calibration with fresh pH 4.0 and 7.0 stranded buffer. The titratable acidity was determined by titrating with 0.1 N NaOH according to AOAC [18].

E. Determination of Free Fatty Acids

The free fatty acids were determined according to the procedure described by Kaur *et al.* [19] with minor modification. Five gram of butter fat was dissolved with 50 ml of neutralized ethanol. Then 0.5 mL of phenolphthalein

was added and titrated with 0.1 N NaOH to obtain the disappearance of pink colour. Results were expressed as a percentage of free fatty Aids (FFAs) with references to oleic acid.

F. Determination of Antioxidant Activity

The FRAP assay was done according to the procedure described by Benzie and Strain [20]. Briefly the FRAP reagent was prepared by mixing 1 ml of (10 mmol/L) TPTZ solution in 40 mmol/L HCl, 1 ml of FeCl₃ (20 mmol/L) and 10 ml of acetate buffer, (0.3 mol/L). Twenty microliters of 0.1 g/ml samples were mixed with 1 ml of FRAP reagent and the absorbance at 593 nm was measured spectrophotometrically after incubation at room temperature for 4 minutes.

G. Determination of Texture Profile

Texture of the garlic butter was analyzed using food rheology tester (IMADA mode FRT series). Hardness, cohesiveness, springiness, gumminess, and chewiness were evaluated from the force/deformation curve as described by Briones-Labarca *et al* [21] using the results drawn into a graph and its obtained using computer software attached to food rheology tester.

H. Sensory Analysis

In sensory evaluation, the butter samples were subjected to nine-point hedonic scale test, and the acceptability of samples was judged by 30 untrained panel members to determine consumer preference as described by Abdalla *et al* [22]. Sensory properties like texture, taste, mouth feel, colour, appearance, aroma and overall acceptability of the butter samples were judged by the panellists during storage.

I. Statistical Analysis

Parametric data were analyzed by using Multivariate Analysis of Variance (MANOVA) and used to determine the significance level of the treatments, while the Duncan's Multiple Range Test (DMRT) was used for mean separation. The sensory analysis was carried out using Friedmans test for non-parametric data analysis.

III. RESULT AND DISCUSSION

A. Physicochemical Attributes of Butter at Day One

The Nutritional attributes and pH of butter made from cow milk with different types of garlic chips and powder are indicated in Table I. There were significant differences ($p < 0.05$) observed in the nutritional properties of the butter. The butter samples are a considerable amount of changes that occurred in biochemical reactions. A higher amount of moisture content ($14.09 \pm 0.10\%$) was observed in without garlic chips and powder added butter, this indicates that 2% garlic chips and 4% garlic powder added butter was the higher source of total solids ($86.14 \pm 0.06\%$) among the other types of butter. There were no significant differences ($p > 0.05$) observed in the moisture content of 2% garlic chips and 2% garlic powder added butter ($13.88 \pm 0.02\%$) and 2% garlic chips and 4% garlic powder added butter ($13.86 \pm 0.06\%$). When considering the fat content of different treatments of butter, the highest fat content

(84.00±0.00%) was observed in without garlic chips and powder added butter and the lowest (80.00±0.00%) in 2% garlic chips and 4% garlic powder added butter. Furthermore, higher free fatty acid content (0.62±0.00%) was observed in 2% garlic chips and 4% garlic powder added butter and lower (0.35±0.02%) in without garlic chips and powder added butter. The higher titratable acidity content (0.31±0.02%) was observed in 2% garlic chips and 4% garlic powder added butter and the lowest acidity value (0.13±0.02%) was shown in without garlic chips and powder butter and pH was observed as negative proportional to titratable acidity.

TABLE I: PHYSICOCHEMICAL ATTRIBUTES OF BUTTER AT DAY ONE

Attributes	Treatments		
	T1	T2	T3
Moisture%	14.09±0.10 ^a	13.88±0.02 ^b	13.86±0.06 ^b
Total solids%	85.91±0.10 ^b	86.12±0.02 ^a	86.14±0.06 ^a
Fat%	84.00±0.00 ^a	82.00±0.00 ^b	80.00±0.00 ^c
fatty acids%	0.35±0.02 ^b	0.59±0.03 ^a	0.62±0.00 ^a
Titratable acidity%	0.13±0.02 ^c	0.25±0.00 ^b	0.31±0.02 ^a
pH	6.33±0.09 ^a	6.13±0.11 ^b	6.09±0.03 ^b

T1= Without adding garlic chips or powder (control), T2= 2% garlic chips 2% garlic powder, T3= 2% garlic chips 4% garlic powder of butter. The Values are means of triplicates ± standard deviation. Mean with the same letters are not significantly different at (p<0.0).

B. Physicochemical Attributes of Butter During Storage

As shown in Table II, garlic chips and powder incorporation affected the moisture content and total solids in different types of butter. The moisture content of the butter (p<0.05) significantly decreased and total solids (p<0.05) significantly increased during the seven weeks of storage period. The variation might be drained of the moisture from butter. Park *et al.* [23] also reported similar variations in their study. The changes (p<0.05) in the pH during the refrigerated storage (7 °C) of butter are presented in Table II. The highest mean value of pH value was observed in without garlic chips and powder added butter and the lowest mean value of pH was shown in 2% of chips and 4% garlic powder added butter but pH was declined during the storage in all treatments. These results were in agreement with that obtained by Zhao *et al.* [24], who reported that the initial pH value of the garlic butter samples had decreased during storage.

Similarly, the changes in the titratable acidity during the storage (7 °C) of butter are presented in Table II. The highest mean value of titratable acidity was observed in 2% of chips and 4% garlic powder added butter and the lowest mean value of titratable acidity was showed in without garlic chips and powder added butter while acid value of butter samples increased, upon storage period, these results were in agreement with that obtained by Mallia *et al.* [25], who reported that the titratable acidity increased gradually during storage of all treatments of butter. The fat value of butter ranged from 84% to 79.66% among the treatments (Table II). The significant (p<0.05) differences were detected among different concentrations of garlic chips and powder added butter but there were not significant (p<0.05) differences in fat content during storage time. This result is in agreement with the study of Dvořák *et al.* [3] and Tarakci *et al.* [26] who reported as butterfat was not subject to

significant changes during the guaranteed period of durability and the storage conditions.

The free fatty acid value of butter ranged from 0.35±0.02% to 0.68±0.02% among the treatments. The significant (p<0.05) differences were detected in free fatty acids among different treatments and also during the storage period (Table II). The highest value of free fatty acid was observed in 2% of chips and 4% garlic powder added and the lowest mean value of free fatty acid was showed in without garlic chips and powder added butter while free fatty acid was increased in all treatments during storage. Shende *et al.* [27] reported similar changes in their studies, during the storage time period of butter of the free fatty acid content. This result is in accordance with the findings of Tarakci *et al.* [26], who reported that the total free fatty acids (TFFA) content was significantly higher in herby milk products than without herb products.

C. Antioxidant Activity of Butter in Butter during Storage Period

As mentioned in Table III the 2% garlic chips and 4% garlic powder added to butter showed the highest antioxidant activity (48.75±1.18 mm/g) at week one and the least value (20.42±2.36 mm/g) was shown in without garlic chips and powder added butter at week 3. According to results in week one, the higher value (48.75±1.18 mm/g) showed in 2% garlic chips and 4% garlic powder added butter compared to other treatments and the least value (-10.83±0.59 mm/g) was shown in without garlic chips and powder added butter. So, garlic has an ability antioxidant activity stated by Hussein *et al.* [28].

D. Texture Profile of Butter during Storage Period

When considering the hardness of the butter, it was not significantly (p>0.05) different with treatment and storage time period (Table IV). But, when considering day 1, the hardness value of 2% garlic chips and 4% garlic powder added butter (3.20±0.72%) was lower than the hardness value of (3.73±0.46%) 2% garlic chips 2% and garlic powder added butter. But when considering day 28 and day 56, the hardness value was lower without garlic chips and powder added to butter and a higher value was showing in 2% garlic chips and 4% garlic powder within the treatments. The cohesiveness, gumminess and springiness were (p<0.05) different among treatments. Hardness, cohesiveness, gumminess, and springiness were an increase in all treatments during the storage time period.

E. Sensory Attributes of Butter at Day One

Sensory parameters taste, mouth feel, colour, appearance, aroma and overall acceptability were showed significantly different (p<0.05) among treatments on day 1 Fig. 1. Maximum score belonged to garlic chips and powder added butter. Further, the taste was observed without garlic chips and powder added to butter. Taste is the primary factor, which determines the acceptability of any product, which has the highest impact on the success of the product [29]. Higher scores for mouth feel, aroma, appearance, and overall acceptability were observed with 2% garlic chips and 4% garlic powder added to butter.

The butter incorporated with 2% garlic chips and 4% powder had the highest score overall acceptability

characteristics based on the organoleptic point of view compared to other treatments. From the overall acceptability scores, 2% garlic chips and 4% garlic powder added butter had the highest score, mean value 7 on a seven-point hedonic scale. The butter without added garlic chips and powder got the lowest score 5 of the overall acceptability on day one of sensorial evaluation. On day one, 2% garlic chips and 4% garlic powder added to butter showed a higher score in colour, taste, mouth feel, appearance, aroma, and overall acceptability. When considering texture and after taste, they were not showed significantly ($p>0.05$) different among

treatments. On the other hand, all the sensory parameters were lower without garlic chips and powder added to butter.

F. Sensory Attributes of Butter at Week Seven

In seventh week, parameters were showed significantly different ($p<0.05$) among treatments during the storage period. Sensory scores for colour and taste, mouth feel, appearance, aroma and overall acceptability were higher scores belonging to butter with 2% garlic chips and 4% powder (Fig. 2). According to results revealed on day one and seven week, most people preferred the butter incorporated with 2% garlic and chips and 4% powder added butter

TABLE II: PHYSICOCHEMICAL ATTRIBUTES OF BUTTER DURING STORAGE

Trt	Attributes	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
T1	Moisture %	14.02±0.11 ^{ab}	14.08±0.03 ^a	14.08±0.22 ^a	13.90±0.11 ^{abc}	13.57±0.71 ^{cdef}	13.61±0.02 ^{cdef}	13.50±0.10 ^{def}
	Total solids %	85.98±0.11 ^{ef}	85.92±0.03 ^f	85.92±0.22 ^f	86.10±0.11 ^{def}	86.43±0.71 ^{abcd}	86.39±0.02 ^{abcd}	86.50±0.10 ^{abc}
	Fat %	84.00±0.00 ^a	84.00±0.20 ^a	83.66±0.58 ^a	83.66±0.58 ^a	83.66±0.58 ^a	83.66±0.58 ^a	83.66±0.58 ^a
	Free fatty acid%	0.37±0.03 ^b	0.41±0.02 ^s	0.41±0.03 ^s	0.42±0.02 ^s	0.42±0.00 ^s	0.41±0.03 ^s	0.43±0.01 ^s
	pH value	6.08±0.13 ^{bc}	6.05±0.22 ^{bcd}	6.01±0.08 ^{bcd}	5.86±0.12 ^{efgh}	5.80±0.05 ^{fghi}	5.72±0.06 ^{ghijk}	5.68±0.03 ^{ijkl}
	Titratable acidity%	0.14±0.03 ^h	0.18±0.08 ^{gh}	0.18±0.03 ^{gh}	0.19±0.02 ^{fgh}	0.20±0.02 ^{efgh}	0.20±0.02 ^{efgh}	0.28±0.02 ^{bcde}
T2	Moisture %	13.75±0.09 ^{abcde}	13.73±0.07 ^{abcde}	13.92±0.26 ^{abc}	13.87±0.30 ^{abcd}	13.67±0.27 ^{bcdef}	13.45±0.09 ^{ef}	13.36±0.06 ^f
	Total solids %	86.25±0.09 ^{bcdef}	86.27±0.07 ^{abcde}	86.08±0.26 ^{def}	86.13±0.30 ^{cdef}	86.33±0.27 ^{abcde}	86.55±0.09 ^{ab}	86.64±0.06 ^a
	Fat %	82.00±0.00 ^b	81.66±0.58 ^b	81.66±0.58 ^b	81.66±0.58 ^b	81.66±0.58 ^b	81.33±0.58 ^b	81.33±0.58 ^b
	Free fatty acid%	0.60±0.01 ^{def}	0.58±0.08 ^f	0.63±0.02 ^{cde}	0.63±0.02 ^{cde}	0.65±0.01 ^{abcd}	0.67±0.00 ^{ab}	0.66±0.00 ^{abc}
	pH value	5.92±0.08 ^{cdef}	5.88±0.09 ^{defg}	5.85±0.07 ^{efgh}	5.81±0.09 ^{fghi}	5.78±0.02 ^{fghij}	5.66±0.07 ^{ijkl}	5.56±0.07 ^{kl}
	Titratable acidity%	0.26±0.01 ^{cdef}	0.26±0.04 ^{cdef}	0.26±0.07 ^{cdef}	0.26±0.02 ^{cdef}	0.29±0.04 ^{bcd}	0.30±0.02 ^{bcd}	0.36±0.04 ^{ab}
T3	Moisture %	13.67±0.10 ^{bcdef}	13.63±0.06 ^{bcdef}	13.68±0.05 ^{bcdef}	13.57±0.21 ^{cdef}	13.56±0.09 ^{cdef}	13.39±0.06 ^{ef}	13.35±0.06 ^f
	Total solids %	86.33±0.10 ^{abcde}	86.37±0.06 ^{abcde}	86.32±0.05 ^{abcde}	86.43±0.21 ^{abcd}	86.44±0.09 ^{abcd}	86.61±0.06 ^{ab}	86.65±0.06 ^a
	Fat %	80.00±0.00 ^c	80.00±0.00 ^c	80.00±1.00 ^c	79.66±0.00 ^c	79.66±0.58 ^c	79.66±0.58 ^c	79.66±0.58 ^c
	Free fatty acid%	0.62±0.00 ^{def}	0.62±0.01 ^{def}	0.63±0.01 ^{bcd}	0.64±0.02 ^{abcd}	0.65±0.01 ^{abcd}	0.67±0.00 ^{ab}	0.68±0.02 ^a
	pH value	5.89±0.11 ^{defg}	5.88±0.08 ^{defg}	5.83±0.14 ^{fghi}	5.71±0.08 ^{ghijk}	5.71±0.07 ^{ghijk}	5.62±0.09 ^{ijkl}	5.50±0.03 ^l
	Titratable acidity%	0.33±0.02 ^{bc}	0.36±0.04 ^{ab}	0.35±0.03 ^{ab}	0.36±0.06 ^{ab}	0.35±0.04 ^{ab}	0.35±0.00 ^{ab}	0.42±0.11 ^a

T1= Without adding garlic chips or powder (control), T2= 2% garlic chips 2% garlic powder, T3= 2% garlic chips 4% garlic powder of butter. The Values are means of triplicates ± standard deviation. Mean with the same letters are not significantly different at ($p<0.0$).

TABLE III: ANTIOXIDANT ACTIVITY OF BUTTER IN BUTTER DURING STORAGE PERIOD

Treatment	Antioxidant activity (Mm/g)		
	T1	T2	T3
Week 1	-10.83±0.59 ^f	37.92±7.07 ^b	48.75±1.18 ^a
Week 2	-15.83±2.95 ^{fg}	25.00±4.12 ^{cd}	32.50±2.95 ^{bc}
Week 3	-20.42±2.36 ^g	7.08±2.36 ^e	18.75±2.36 ^d

T1= Without adding garlic chips or powder (control), T2= 2% garlic chips 2% garlic powder, T3= 2% garlic chips 4% garlic powder of butter. The Values are means of triplicates ± standard deviation. Mean with the same letters are not significantly different at ($p<0.0$).

TABLE IV: PHYSICAL PARAMETERS OF BUTTER DURING STORAGE PERIOD

Treatments	Days	T1	T2	T3
Hardness (N)	Day 1	3.27±0.32 ^b	3.73±0.46 ^{ab}	3.20±0.72 ^b
	Day 28	3.53±0.21 ^{ab}	3.87±0.23 ^{ab}	3.97±0.45 ^{ab}
	Day 56	3.73±0.25 ^{ab}	4.17±0.29 ^a	4.23±0.49 ^a
Cohesiveness	Day 1	0.19±0.12 ^d	0.22±0.14 ^{cd}	0.29±0.20 ^{bcd}
	Day 28	0.35±0.04 ^{bcd}	0.34±0.04 ^{bcd}	0.46±0.15 ^{ab}
	Day 56	0.42±0.12 ^{abc}	0.57±0.03 ^a	0.58±0.07 ^a
Gumminess (N)	Day 1	0.63±0.43 ^d	0.83±0.57 ^{cd}	0.93±0.61 ^{cd}
	Day 28	1.23±0.22 ^{bcd}	1.31±0.14 ^{bcd}	1.85±0.79 ^{ab}
	Day 56	1.60±0.58 ^{abc}	2.39±0.31 ^a	2.45±0.27 ^a
Springiness	Day 1	0.41±0.07 ^c	0.50±0.08 ^{abw}	0.54±0.02 ^a
	Day 28	0.42±0.04 ^{bc}	0.56±0.03 ^a	0.54±0.00 ^a
	Day 56	0.48±0.06 ^{abc}	0.56±0.02 ^a	0.55±0.01 ^a

T1= Without adding garlic chips or powder (control), T2= 2% garlic chips 2% garlic powder, T3= 2% garlic chips 4% garlic powder of butter. The Values are means of triplicates ± standard deviation. Mean with the same letters are not significantly different at ($p<0.0$).

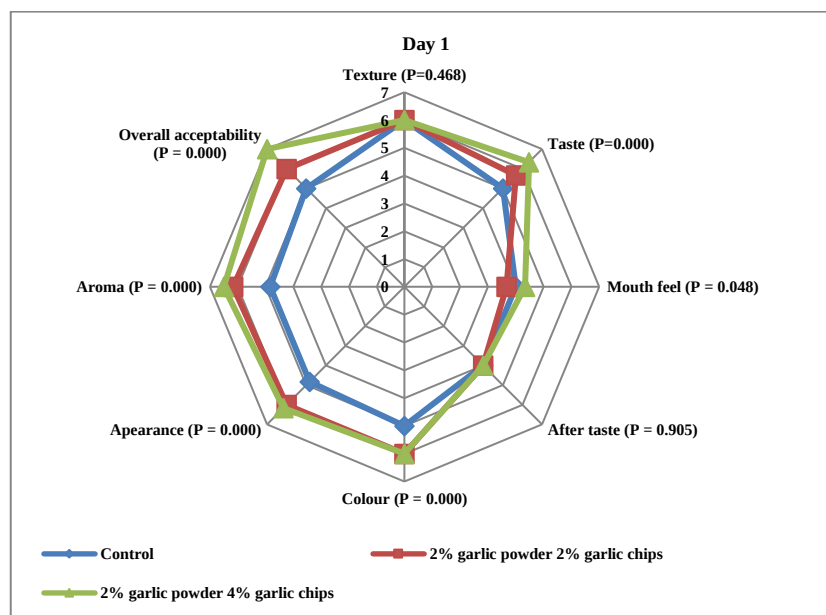


Fig. 1. Sensory attributes variation at day one evaluation.

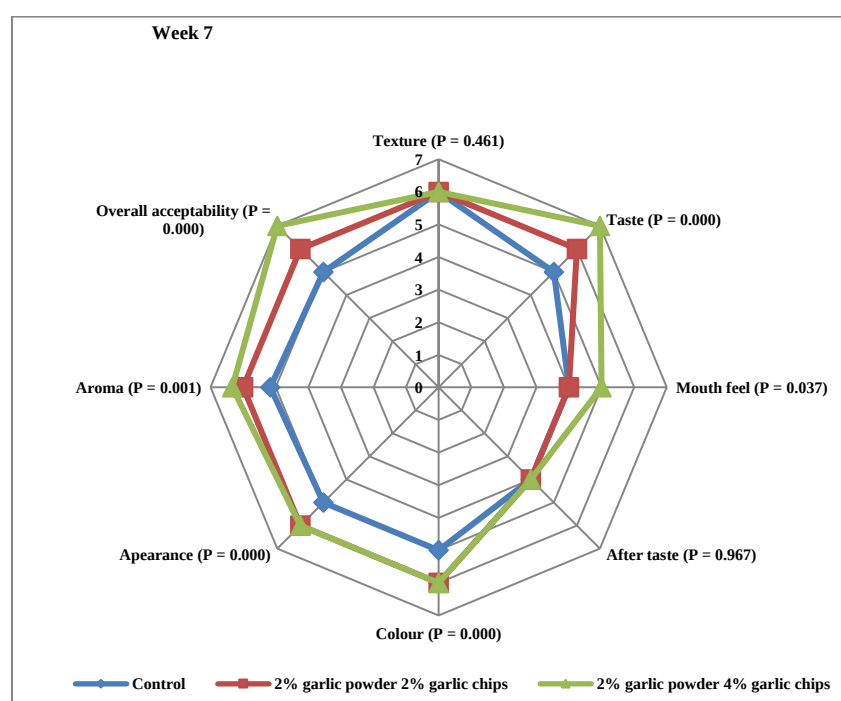


Fig. 2. Sensory attributes variation at seven week storage.

IV. CONCLUSION

This study revealed that the 2% garlic chips and 4% garlic powder incorporated in butter had the highest overall quality during the storage period compared to other treatments. On day one, the attributes like moisture, total solids, fat, free fatty acids, titratable acidity, and pH were different among the treatments. The antioxidant activity was different among the treatments in week one. During the storage of moisture, total solids, fat, free fatty acids, titratable acidity, pH, and antioxidant activity were changed. During storage, the hardness, cohesiveness, gumminess, and springiness were increased. Finally, 2% garlic chips and 4% garlic powder incorporated in butter were more suitable for consumers.

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