

QUALITY CHARACTERISTICS OF BACTRIAN CAMEL (*Camelus bactrianus*) MEAT BURGER AND EVALUATING ITS STABILITY DURING THE STORAGE

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ABSTRACT

Camel meat is a kind of lean meat with a high animal protein content, which has a lower fat and cholesterol content than other animal meat. Using camel meat as raw material, we determined the optimal processing craft of the camel meat burger, followed by an analysis on the quality changes of the burger under storage conditions of 4 and -20°C. After response surface optimisation, the best formula for the camel burger was found to be a 1:5 ratio of fat to lean, with 15% ice water and 0.5% isolated soybean protein. The experimental storage results of the camel burger showed that, under the storage condition of -20°C for 3 months, the variation in the moisture activity value, pH value, thiobarbituric acid reactive substances value, colour value, flavour, etc., were smaller than that under the storage of 4°C, which could better extend the shelf life of the product.

Key words: Bactrian camel meat, burger patty, quality characteristics, shelf life

Bactrian camels are a suitable source of milk and meat for the population of east and central Asia. Bactrian camel milk has been extensively exploited for human health (Amanat *et al*, 2019), and processed into industrial dairy products such as milk powder, yoghurt, and ice cream. Abdel-Naeem and Mohamed (2016) found that addition of ginger extract and papain powder during formulation of camel burger patties can improve their physico-chemical and sensory properties. Al-Juhaimi *et al* (2018) investigated the phytochemical composition and antioxidant activity of Argel leaf powder (ALP) and its effect on the quality attributes of camel patties and found that it improved shelf life and product quality. However, there are limited research on bactrian camel meat, especially, the development of camel meat products in China (Park and Young, 2009).

Camel meat varies in composition according to breed type, age, sex, feeding condition, and site on the carcass (Kadim *et al*, 2006). Similar to the meat of other ruminants, camel meat is rich in moisture contents, about 70-77% moisture (Al-Owaimer, 2000), and has a good water holding capacity, hence it possess good processing properties (Babiker and Yousif, 1990) that

can be recommended as an important raw material for the production of various meat products (Abdel-Naeem and Mohamed, 2016). In addition to high level of vitamins, especially vitamin B complex makes camel meat a healthy food for humans (Kadim *et al*, 2008), as well as good quality proteins, about 20-23% (Kadim *et al*, 2006), especially essential amino acids, which makes it a good source of high quality protein in arid and semi-arid regions. At the same time, camel meat contains low fat content with relatively high polyunsaturated fatty acids, and low level of cholesterol, which makes camel meat considered as a healthy option for patients with cardiovascular disease (Kadim *et al*, 2008; Raiymbek *et al*, 2019).

Recently, due to the rapid increase in consumer demand for healthy fast food, many efforts have been taken to improve the quality and stability of burgers (Papadima and Bloukas, 1999), with camel meat being one of the best candidates due to their high level of nutrition and low level of fat and cholesterol content. Some authors have reported that dromedary meat can be used to successfully in cooked burger patties (Kadim *et al*, 2008; Heydari *et al*, 2016), however, research on bactrian camel meat burger is scarce.

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The goal of the present study was to evaluate the use of bactrian camel meat in order to produce a meat burger and to assess its stability during 3 months of storage at 4°C and -20°C.

Materials and Methods

Bactrian camel lean meat and hump fat were obtained from 3 animals (2 years old), which were slaughtered at a local abattoir (Alashan, Inner Mongolia, China). The meat and fat were vacuum packed and rapidly transported to the laboratory and maintained in freezer at -20°C until processed.

Products formulation

The main process and key influencing factors of the processing of camel meat burger patties are the proportion of lean and fat, ice water, and isolated soy protein addition. Based on previous study, the three-level-three-factor BBD (Box-Behnken designs) for the proportion of lean and fat, ice water, and isolated soy protein were carried out with the sensory score as the response value. Each group of tests was made in three parallels, and the average value was taken as the response value. The level code of each factor was shown in Table 1. The experimental design and results were shown in Table 2, in which the response value Y represents the sensory score.

Table 1. The factor level of Box-Behnken experiment.

Factors	A	B	C
Levels	Proportion of lean and fat (%)	Ice water (%)	Isolated soy protein (%)
-1	10	10	0.3
0	20	15	0.5
1	30	20	0.7

A: Proportion of lean and fat (%); B: Ice water (%); C: Isolated soy protein (%).

After the addition of the camel lean and fat, ice water, isolated soy protein, the treatment were mixed with salt (2%), sugar (1%), paprika (0.2%), ginger powder (0.2%), onion (3%), pepper (0.2%), and soy sauce (0.2%) for burger.

Burger processing and storage

Three independent replicates for burger formula were processed. After thawing overnight in a cooler (4°C), the camel meat and fat were ground through a 5mm plate grinder (sxc12/22, China), and were mixed together with water, isolated soy protein, salt, sugar, onion and other seasonings. This mixture was shaped using a commercial burger maker to obtain patties of approximately 90g, and the dimensions of 10cm

diameter and 1cm thickness. Then the burger patties were placed in polyethylene packages and stored at -20°C for 3 months. For each replicate, samples were withdrawn for analysis at 1st day (0-time) and every one month.

Table 2. The experimental design and results of Box-Behnken.

Run	A	B	C	Y
1	30.00	15.00	0.70	61.00
2	20.00	20.00	0.70	69.00
3	30.00	15.00	0.30	64.00
4	20.00	15.00	0.50	88.00
5	20.00	15.00	0.50	86.00
6	20.00	15.00	0.50	87.00
7	10.00	15.00	0.70	64.00
8	20.00	10.00	0.70	67.00
9	10.00	10.00	0.50	62.00
10	20.00	15.00	0.50	87.00
11	10.00	15.00	0.30	65.00
12	20.00	15.00	0.50	87.00
13	30.00	10.00	0.50	65.00
14	30.00	20.00	0.50	61.00
15	20.00	20.00	0.30	70.00
16	10.00	20.00	0.50	68.00
17	20.00	10.00	0.30	69.00

A: Proportion of lean and fat (%); B: Ice water (%); C: Isolated soy protein (%).

Sensory evaluation

According to the experimental design (Table 2), sensory analysis was performed by 30 experienced panelists who were recruited from the staff and students of the Food Science and Engineering College, Inner Mongolia Agricultural University, Inner Mongolia, China. Panelists were selected on the basis of previous experience in consuming traditional burgers. The whole process of the sensory experiment was carried out in a sensory laboratory at the University. Rectangular pieces of approximately 1.5-2cm were prepared from the centre of burger patties and served at room temperature. The burger patty samples were provided to each panelist randomly, and three replicates of all of the experimental designs were evaluated. Tap water was provided between the samples to cleanse the palate. The evaluation considered juiciness, texture, flavour, and colour and asked participants to assign a numerical value from 1 to 25, in which the highest score of 25 expressed extremely acceptable, and 1 represented extremely unacceptable. At the end of the test, panelists were asked to give a score to each indicator (juiciness,

texture, flavour and colour), and the total score was from 0 to 100.

Burger patties analysis

The proximate chemical analysis of camel raw meat and burger patty, and microorganism indicators were determined at 0-time only. Meanwhile, water activity (A_w), pH, thiobarbituric acid reactive substances (TBARS), and colour values were evaluated at 0-time, and every month for 3 months, at the 4°C and -20°C storage temperature, respectively. In addition, the electronic tongue values and aerobic plate counts were also calculated at 0-time and every one month for 3 months at storage temperatures of 4 and -20°C, respectively. The burgers were thawed in a chiller at 4°C before analysis.

The proximate chemical composition

The moisture, crude protein, crude fat, and ash contents of bactrian camel meat and burger patties were determined for three replicates, according to the procedure described by the National Food Safety Standard of China. In brief, moisture was determined using the direct drying method in GB (GuoBiao, namely national standard) 5009.3-2016. The protein content was assessed using the Kjeldahl method (automatic kjeldahl nitrogen analyser, K9860, China) in GB 5009.5-2016, and the Soxhlet extraction method was evaluated for measuring the fat content (GB 5009.6-2016). Finally, the ash content was determined by ashing the samples in a muffle furnace (SX2-4-10, China) at 500°C for 24h (GB 5009.4-2016).

pH and Water activity (A_w)

The pH and water activity values were determined after processing as well as every month for 3 months at storage temperature of 4 and -20°C, through the methods of GB/T9695.5-2008 and GB/T9695.19-2008, and where three readings for each sample were obtained and the mean was calculated. Briefly, the pH value was measured with a pH meter (PB-10, China) on a suspension, resulting from blending a 15g sample with 150mL deionised water for 2min, while the water activity value was assessed in the intelligent water activity meter measuring instrument (HD-3A, China).

Lipid oxidation (thiobarbituric acid test)

The thiobarbituric acid reactive substances (TBARS) value was measured by the method described by Du and Ahn (2002), after processing and every month for 3 months at 4°C and -20°C storage temperatures, respectively. The mixture solutions

(10g burger patties, trichloroacetic solution, and TBA solution) were heated for 40 min in a 90°C water bath (DK-S28, China), cooled under running water, and the supernatant was obtained at 5500rpm for 25min in a centrifuge (5811FN279354, German). The supernatant absorbance was measured at 532nm and 600nm using a UV spectrophotometer (Cambridge, U.K.), and absorbance values of A532 and A600 were recorded, respectively. Finally, the TBA value was calculated using the following formula: $TBA (mg/100g) = (A_{532} - A_{600}) / 155 \times (1/10) \times 72.6 \times 100$.

Colour evaluation

The surface colour of the burger patties was assessed using a colorimeter (TCP2, China) calibrated with a white plate and light trap supplied by the manufacturer. Three readings were taken on the burger patty surface, and a mean value was processed. The CIELAB Colour System 1976 (Allais *et al*, 2010) Colour space values (a^* for redness, L^* for lightness, and b^* for yellowness) were assessed using a colorimeter (Konica Minolta, CR-400- Japan; Measuring aperture: 8mm; Illuminant: CIE D65; Observer angle: CIE 2° Standard Observer) (Mancini and Hunt, 2005).

Microbiological analysis

Microbiological analysis was completed after the samples were cooked in order to examine the hygienic quality of the burger patty processing according to the food microbiological examination from national food safety standard (China). The samples (25g) were homogenised with a 225mL phosphate buffer (Tianjin Yongda Chemical Reagent Co., Ltd., China) for 1-2min in order to obtain the liquid sample homogenate. Then, further serial dilutions were prepared for microbial determinations (GB4789.2-2010). Finally, the aerobic plate counts were determined on Plate Count Agar.

The enumeration of coliforms (*E. coli*) was counted using the multiple-tube fermentation test and was expressed as the most probable number (MPN)/g sample (GB4789.3-2010).

Salmonella testing was performed by a pre-enrichment with an a-peptone water buffer and then enriched samples were applied to the 1-2 test, according to the manufacturer's directions from GB4789.4-2010.

The samples (25g) were homogenised with a 225mL sodium chloride broth (7.5%) for 1-2min, and were incubated at 36°C for 18-24h. Then, the above cultures were inoculated on Baird-Parker plates

and were cultured at 36°C for 18-24h to completed *Staphylococcus aureus* testing (GB4789.10-2010).

The samples (25g) were homogenised with 225mL Shigella Enriched Broth (Tianjin Yongda Chemical Reagent Co., Ltd., China) for 1-2min, and were incubated in an anaerobic environment at 42°C for 16-20h. Then, the *Shigella's* enrichment solution was inoculated on a Xylose Lysine Deoxycholate (XLD) agar plate, and MacConkey (MAC) agar plate, and cultured at 36°C for 20-24h to complete the *Shigella* testing (GB4789.5-2010).

Electronic tongue

An electronic tongue (SA402B, Insent Company, Japan) was used to analyse the prepared camel meat burger patty samples, and the analysis sensor detected spicy, sweet, salty, sour, bitter, and umami in the burger patties (Charles *et al*, 2017; Schlossareck and Ross, 2019). Prior to the analysis, the sensors were hydrated in 25mL Milli-Q water for 24h. A sample of 30g of burger patty was diluted with water at a ratio of 1:5, and the fat impurities were removed through centrifugation (5000rpm, 10min). Finally, the supernatant was measured using an electronic tongue. During the analysis, the sensors were rinsed in 25mL of Milli-Q water for 10s between each sample (Charles *et al*, 2017).

Statistical analysis

The statistical data analysis for the three independent replicates was carried out using SPSS® software program version 21 (SPSS, Chicago, IL, USA) for Windows. Design of Expert 8.0.6 (DOE Version 8.0.6, StatEase. Inc, Minneapolis, MN, USA) was used for the experiment design, graph construction, and results analysis. A difference was considered significant at $p < 0.05$. Data were expressed as mean \pm standard deviation.

Results and Discussion

The experimental design and regression analysis

The three-level-three-factor Box-Behnken designs (BBD) for the proportions of lean and fat, ice water, and isolated soy protein were carried out with the sensory score as the response value. The experimental design and results are shown in Table 2. Furthermore, based on the results of the BBD, the square regression analysis of the response value Y (sensory value) was implemented, and the quadratic polynomial regression equation of Y was obtained as follows:

$$Y = -121.28 + 6.425A + 11.65B + 231.25C - 0.05AB - 0.25AC + 0.25BC - 0.14125A^2 - 0.355B^2 - 234.375C^2$$

In the equation, Y was the sensory value of the camel meat burger patties, and A, B, and C represented the proportion of lean and fat, ice water, and isolated soy protein, respectively. The Y response surface regression model was extremely significant ($p < 0.0001$), and the linear relationship between the dependent variable and all of the independent variables were significant ($R^2 = 0.9987$), while the lack of fit was not significant ($p > 0.05$). The equation correction coefficient Adj $R^2 = 0.9971$ demonstrated that the change of the response surface of 99.71% could be explained by this model, and there was a good fit between the experimental data and the regression equation. Therefore, the regression equation model was established, and it is appropriate to use this model to predict the sensory value of the camel meat burger patties. Finally, the camel meat burger patties were comprehensively optimised to be proportions of lean and fat of 20%, ice water of 15%, and isolated soy protein of 0.5%. At this time, the comprehensive evaluation of the sensory value was 88 (Table 2).

The chemical analysis of raw camel meat and burger patties

The results of the proximate chemical composition of the camel meat and camel meat cooked burger patties based on the optimal formula design were presented in Fig 1. The content of the moisture, protein, fat, and ash from the raw camel meat were 75.50%, 22.58%, 1.64%, and 1.33%, respectively. Among them, the content of the moisture, protein, and ash were similar to that of dromedary camel meat, while the content of fat was slightly lower than that in dromedary meat (Al-Owaimer *et al*, 2014), which is related to the bactrian camel meat samples collected. In this experiment, we used camel meat from a 2 year old bactrian camel, and studies have shown that the fat content of camel meat may increase with age (Kadim *et al*, 2008). Therefore, the young age of the bactrian camel leads to less fat in its meat. In the cooked camel burger patties, the protein and fat content were increased, by 40.47 and 24.30%, respectively. During cooking, some soluble proteins were separated from the meat, and the high fat content was mainly related to the content of the proportion of fat and lean in the formula. The aerobic plate counts and *E. coli* in the camel burger patties were lower than that of the national standard, which indicated our products had a good quality.

Changes in the quality of camel burger patties during storage

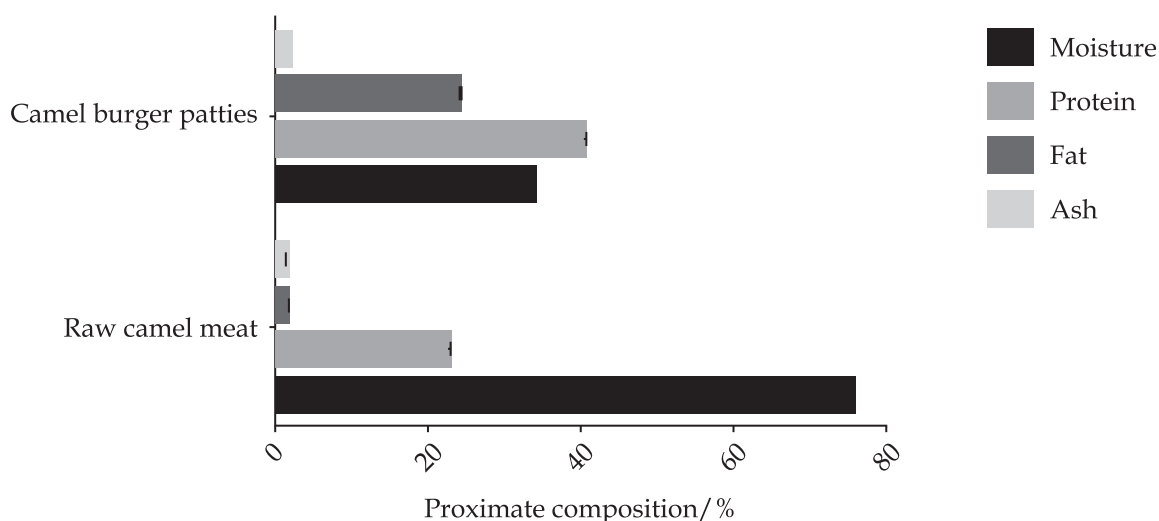
Water activity (Aw), pH, and thiobarbituric acid reactive substances (TBARS) values

The Aw, pH, and TBARS values were calculated after processing and monthly during storage. Under storage conditions of 4°C and -20°C, the Aw and pH values had a downward trend (Table 3). The Aw and pH values for all of the storage time were significantly ($p < 0.05$) lower than those of the control samples during the 4°C storage time; whereas, there was no significant ($p < 0.05$) difference among the values of 0-time and after the first month at the -20°C storage time. The slight change in pH values of the treated burger patties may be attributed to the effect of these enzymes on the ionic strength of the meat.

Water activity (Aw) refers to the degree of water binding. There is an inverse relationship between

water activity and degree of binding; the higher the water activity value, the lower the degree of binding. The value of the water activity is directly related to the growth rate of microorganisms. With the extension of the storage time, the degree of water binding and the growth rate of the microorganisms were increased in this study.

The degree of lipid oxidation is one of the indicators reflecting fat oxidation. The TBARS value can be used to indicate the degree of fat oxidation (Fernández *et al*, 1997). In present study, the TBARS values of different storage times were significantly ($p < 0.05$) lower than that of the control during frozen storage for 3 months. With the extension of the storage time, the fat oxidation increased slowly in the camel meat patties, and compared with the condition at -20°C, the degree of fat oxidation was slightly lower than that at 4°C. In addition, the rate of TBARS evolution during the storage time was



Values represent the mean of 3 independent replicates \pm SD.

Fig 1. Proximate chemical composition of raw camel meat and camel burger patties.

Table 3. The value of Aw, pH and TBARS from camel meat burger patties during storage at 4°C and -20°C for 3 months.

Treatments	Storage time (days)/4°C			
	0-time	1st month	2nd month	3rd month
Aw	0.885 \pm 0.003 ^a	0.866 \pm 0.005 ^b	0.833 \pm 0.002 ^c	0.817 \pm 0.002 ^d
pH	6.460 \pm 0.000 ^a	6.280 \pm 0.010 ^b	5.960 \pm 0.010 ^c	5.817 \pm 0.006 ^d
TBARS	0.331 \pm 0.004 ^a	0.932 \pm 0.031 ^b	1.961 \pm 0.046 ^c	3.867 \pm 0.047 ^d
Treatments	Storage time (days)/-20°C			
	0-time	1st month	2nd month	3rd month
Aw	0.885 \pm 0.002 ^a	0.884 \pm 0.002 ^a	0.872 \pm 0.002 ^b	0.867 \pm 0.002 ^c
pH	6.460 \pm 0.000 ^a	6.440 \pm 0.000 ^b	6.387 \pm 0.006 ^c	6.210 \pm 0.000 ^d
TBARS	0.331 \pm 0.004 ^a	0.597 \pm 0.009 ^b	1.014 \pm 0.059 ^c	1.621 \pm 0.016 ^d

Aw: water activity; TBARS: thiobarbituric acid reactive substances; a-b Means with different superscripts within the same row are significantly ($p < 0.05$) different. Values represent the mean of 3 independent replicates \pm SD.

faster than that reported for dromedary meat stored under refrigeration conditions (Abdel-Naeem and Mohamed, 2016). It could be due to the mincing process (which favours the oxygen access).

Colour evaluation

The myoglobin and haemoglobin in the muscle mainly determine the colour quality of the meat. The colour of the surface of the meat and meat products contain L* (lightness), a* (redness), and b* (yellowness) (Kadim *et al*, 2006). The larger the value of L*, the better the brightness of the meat, and the larger the value of a*, the greater the redness of the meat. The measurement results of the changes in colour during the storage of the camel meat burgers are shown in Table 4. Under 4°C storage conditions, the different storage times had a significant ($p < 0.005$) effect on the colour value (L* and a*) of the camel meat burger patties, which indicated that a higher storage temperature had a great influence on the colour brightness and redness of meat; while the b* values of 0-time were significantly ($p < 0.05$) lower than that of the other groups (1st-3rd month), which suggested that the extended storage time had no great

effect on the yellowness of the meat. Under -20°C storage conditions, during the first two months of storage, the L* value of the meat increased slowly, but there was no significant ($p > 0.005$), while a significant difference ($p < 0.05$) existed between the 3rd month and other storage times, which showed that under lower storage temperature, the colour change range of meat can be extended more efficiently.

Microbiological analysis

After the camel meat burger patties were vacuum packaged, the aerobic plate counts were calculated under the normal temperature storage, storage conditions of 4 and -20°C. After the 1st month, the higher aerobic plate counts of the normal temperature were significantly different ($p < 0.005$) compared with the other storage conditions (2nd month and 3rd month). During the second storage month, the aerobic plate counts exceeded the measurement range at the normal temperature storage conditions, while the aerobic plate counts stored at 4 and -20°C were 8.1×10^4 and 1.4×10^4 , respectively. During the third storage month, the aerobic plate counts exceeded the measurement range

Table 4. The colour components of camel meat burger patties during storage at 4°C and -20°C for 3 months.

Treatments	Storage time (days)/4°C			
	0-time	1st month	2nd month	3rd month
L* (lightness)	47.673±1.685 ^a	50.873±1.183 ^b	42.620±0.040 ^c	35.590±0.682 ^d
a* (redness)	13.497±1.034 ^a	11.130±0.551 ^b	5.500±0.241 ^c	3.457±0.411 ^d
b* (yellowness)	10.727±0.827 ^a	15.283±1.845 ^b	16.117±1.102 ^b	17.867±0.516 ^b
Treatments	Storage time (days)/-20°C			
	0-time	1st month	2nd month	3rd month
L* (lightness)	47.673±1.685 ^a	48.077±0.827 ^a	50.227±0.699 ^a	39.490±0.775 ^b
a* (redness)	13.497±1.034 ^a	11.573±0.432 ^b	11.430±0.131 ^b	7.907±0.898 ^d
b* (yellowness)	10.727±0.827 ^a	13.967±0.492 ^b	15.480±0.624 ^b	16.967±0.293 ^c

Table 5. Electronic tongue result of camel meat burger patties during storage at 4°C and -20°C for 3 months.

Treatments	Storage time (days)/4°C			
	0-time	1st month	2nd month	3rd month
Umami	14.580±0.010 ^a	12.287±0.005 ^{ab}	10.740±0.010 ^{ab}	9.333±0.005 ^b
Bitterness	-5.403±0.005 ^a	-2.953±0.005 ^{ab}	-1.083±0.005 ^{ab}	-0.897±0.005 ^b
Astringency	-12.183±0.005 ^a	-11.250±0.010 ^{ab}	-4.253±0.015 ^{ab}	-4.010±0.010 ^b
Saltiness	29.193±0.005 ^a	26.403±0.005 ^{ab}	14.687±0.005 ^{ab}	11.380±0.010 ^b
Sourness	-21.620±0.010 ^a	-20.257±0.028 ^{ab}	-14.960±0.026 ^{ab}	-12.327±0.006 ^b
Treatments	Storage time (days)/-20°C			
	0-time	1st month	2nd month	3rd month
Umami	14.580±0.010 ^a	11.413±0.015 ^{ab}	12.450±0.010 ^{ab}	11.237±0.006 ^b
Bitterness	-5.403±0.006 ^a	-4.830±0.040 ^b	-2.733±0.006 ^c	-2.557±0.006 ^d
Astringency	-12.183±0.006 ^a	-11.247±0.006 ^b	-9.973±0.006 ^c	-6.567±0.006 ^d
Saltiness	29.193±0.006 ^a	26.397±0.006 ^b	17.737±0.006 ^c	14.047±0.012 ^d
Sourness	-21.620±0.010 ^a	-19.887±0.031 ^b	-18.737±0.031 ^c	-16.437±0.006 ^d

at the 4°C storage conditions. From the record of the aerobic plate counts, it can be concluded that the shelf life of our camel meat patty product was only about 30 days at normal temperature, and could be extended to 60 days under low temperature storage at 4°C, and could be extended to more than 90 days under a -20°C storage temperature.

Electronic tongue analysis

The electronic tongue was used to detect the five taste sensor signals of camel meat burger patties, namely: umami, bitter, astringent, salty, and sour during storage at 4 and -20°C (Table 5). Each sensor of the electronic tongue can respond to the camel meat burger patties in different storage periods at different storage conditions. Different signal response values indicated that the sensors have different sensitivities to camel meat burger patties in different storage periods. Among them, the signal response value of each group was the weakest at 0-time, and the signal response at the end of storage was the strongest. During the storage period of 4°C, the response value of umami gradually decreased with the increase of days, reaching 9.333 at the 3rd month; the response value of bitterness gradually increased, and finally reached -0.897; the response value of astringency increased slowly within 0-30 days, and then increased significantly after the 1st month. During the storage period, vacuum packaging and ice temperature storage can better maintain the original flavour of the product. During the storage period of -20°C, the response values of the five taste sensors changed very little. The response value of umami gradually decreased with the increase in days. The response value of the bitterness gradually increased, and the change trend was relatively stable, and finally reached -2.557. The response value of the astringent taste increased slowly; the response value of salty taste decreased from 29.193 to 14.047 after the 3rd month. During the storage period of -20°C, the change of the signal value of each sensor was less than that of 4°C, indicating that under storage of -20°C, the flavours of the camel meat burger patties can be better preserved.

Conclusions

The results from this study indicated that the manufacture of burgers from Bactrian camel meat is a viable option for an industry that has largely released its products to the fresh meat market. The results of the camel meat burger patties process conditions showed that the amount of fat and lean ratio had a greater impact on the meat texture and elasticity; the

addition of isolated soy protein had a significant effect on the meat chewability; and the addition of ice water had a great effect on the hardness, taste, and shaping of the camel burger patties. After optimising the response surface, it was determined that the optimal ratio was 20% for the fat and lean ratio, 0.5% for the isolated soybean protein, and 15% for ice water. When exploring the best storage method, the water activity value, thiobarbituric acid value (TBARS) value, and colour components of the storage time within 3 month of storage at -20°C were lower than the storage of 4°C, which indicated that the storage condition of -20°C made it easier to extend the shelf life, and better for retaining the flavour of the camel meat burger patties.

Acknowledgements

This work was supported by grants from the National Key Research and Development Project (2020YFE0203300), the Inner Mongolia Natural Science Foundation Project (2018BS03017), Inner Mongolia Autonomous Region Science and Technology Innovation Guide Project (KCMS2018048), and double-class discipline innovation team building (NDSC2018-14).

Conflicts of Interest

The authors declare no conflict of interest.

Ethical guidelines

Ethics approval was not required for this research.

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