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Enhancing chicken sausage quality: Investigating the impact of chicken skin fat and corn starch powder on physicochemical attributes, textural properties, and storage stability

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ABSTRACT

The aim of this research work is to investigate the effect of fat (chicken skin) and corn starch powder (CSP) at concentrations of 30%, 40% & 50% and 5%, 10%, & 15% respectively in the physicochemical, textural, and quality characteristics of chicken sausage during the storage (4±2ºC) for 28 days. Physicochemical properties like protein, fat, colour, moisture content, water holding capacity (WHC), peroxide value, and pH; textural properties like hardness, cohesiveness, springiness, chewiness, and gumminess; and sensory parameters were evaluated. The colour "L" and "b" values, fat and overall acceptability of the chicken sausage increased as the level of chicken skin and CSP increases; in sensory evaluation the chicken sausage with 50% chicken skin and 15% CSP got the highest overall acceptability (7.8). All the textural parameters decreased as chicken skin and CSP increases. Storage studies implied that the chicken sausage stored in refrigerator for 28 days retained the quality of the sausages.

1. Introduction

Sausage is a food item which is stuffed with well-seasoned minced meat usually in a casing of prepared animal intestine or artificial sausage casing usually made from cellulose, collagen, and plastic and may always not be edible. Sausages are the best source of protein which is the power source of amino acids, healthy benefitting minerals, and the essential vitamins which is required for proper body functioning (Verbeke *et al.,* 2010). Sausages are available in supermarkets in big metropolitan cities in a number of varieties such as the pork sausages, chicken sausages, beef sausages etc. As we are living in a fast-changing world, people don't get enough time for preparing their food and this type of food provides a quick, convenient, and ready-to-eat food item. In order to increase the quality and lower the price of the meat goods, non-meat ingredients are used. The components in these meat products come from a variety of sources, including dairy, eggs, plants, and microorganisms, including probiotics (Xiong, 2012; Yadav *et al.,* 2013). In order to improve the emulsified properties of the sausage product, starches could be used as "binders." Additionally, starches used in non-meat components can promote the production of higher-quality, healthy sausage.

Local herbs in Manipur (a small state in northeastern part of India) such as Wild coriander (Sa maroi) and Prickly winged leaf (Mukthrubi) are very popularly used in curry and also in condiments. Wild coriander (*Eryngium foetidum L*) exhibits anticonvulsant, antimicrobial and analgesic properties. They are also rich in Vit A, Vit B1, Vit B2, Vit C, calcium, and iron. Prickly winged leaf (*Zanthoxylum armatum*) is an antioxidant, anti-inflammatory, cytotoxic, nootropic and anti-fungal and anti-bacterial property.

In Manipur, sausages were made traditionally from time immemorial specially the tribal communities of the state as a special dish which is eaten in certain special occasions and in feast when the whole pig is being slaughtered. The sausages were traditionally made from the pork innards, blood along with the locally grown traditional herbs and spices which is stuffed into the thoroughly washed and cleaned pork small intestine. Packed sausages mainly pork, chicken, beef sausages are also available commercially in the market mostly in frozen forms which is imported from others states or countries. The sausages which is usually available in the market is added and mixed with soybean, potatoes etc., which hamper the taste of the sausages and the price is

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skyrocketed which makes lots of people to try for one time basis only.

So, this research is an attempt to develop an indigenous chicken sausage which is enrich with different health benefits, taste, and aroma from the local herbs. This research will also give a new dimension in the variety of sausages which is available in the local market that will give chicken lovers an all-new taste and add to the variety. And the people will get to eat chicken sausages which is indigenous, and with a touch of the indigenous herbs at relatively cheaper price. Also, the local micro-food processing factories and the food entrepreneurs will also get a new ideas and technology which will enhance the growth, development, and income of their factories.

Thus, this study has been undertaken to develop healthy and nutritious chicken sausage from chicken (breast), fat (chicken skin, CS), binder (corn starch powder, CSP) and local herbs (Sa maroi, Wild coriander) and (Prickly winged leaf, Mukhrubi) with the following objectives.

Objectives

i. Formulation and development of chicken sausage incorporated with wild coriander and prickly winged leaf.
ii. Impact of fat-corn starch powder on quality characteristics of the chicken sausage
iii. Storage study and sensory evaluation of the chicken sausage

2. Materials and method

2.1 Raw materials

Chicken breast, chicken skin was purchased from the nearby local meat shop. The remaining ingredients of the research project such as onion, garlic, ginger., egg, corn starch, salt, red chilli powder, vegetable oil, prickly winged leaf, wild coriander were purchased from the local general store and the casing (processed sheep intestine) were purchased online.

2.2 Chicken sausage preparation

The skin and breast of the chicken were completely rinsed with clean water two to three times. The chicken was then deboned, cut into cubes, and the skin was sliced into thin strands. After that, they were marinated in salt for 1-2 hours to flavour and tenderise the flesh. The marinated poultry was combined with the other ingredients along with some chilled water, and everything was minced and mixed completely in a food processor. With the aid of a correctly oiled funnel, the minced components were manually added. To ensure correct removal of air bubbles and uniform filling distribution throughout the casing, the end of the casing was fastened to the bottom of the funnel, and the minced ingredients were stuffed from the top of the funnel. The sausage ends were then sealed and tied off at the appropriate length. The sausages were vacuum packed and were stored in the refrigerator (4±2ºC) until further analysis. As a treatment for the experiment, the binders, fat, and herbs were added individually at various concentrations. Three replicates of each treatment were carried out.

2.3 Boiling of the chicken sausage

Boiling of the sausage was done at 80ºC for 20 min as it was the optimised parameters using boiling clean portable water. The boiling process was done in a boiling bath with a control option for temperature of 8 litre capacity. Boiled chicken sausages were experimented for texture, colour, water holding capacity characteristics. Sensory properties of chicken sausages were estimated by a group of 10 panellist. Nine-point Hedonic scale test was used to access sensory aspects viz., texture, appearance, taste, aroma, flavour, and overall acceptability for each sample.

2.4 Proximate Analysis of Sausage

Samples of sausages were examined to determine the proximate composition of sausages, including their moisture content (dry matter), protein content, and fat content. In accordance with the (AOAC 2000) technique, the moisture content of the sausages was assessed by oven drying at 105°C to obtain constant weight. According to the AOAC method, the Kjeldahl method was used to measure the protein content of the sausage. Using a solvent extraction method based on the AOAC technique, the Soxhlet method was used to measure the fat content of the sausage.

2.5 Determination of Colour

The Color Flex EZ spectrophotometer was used to examine the sausages' colour parameters. According to the CIE Lab system, the colour is represented by the following parameters: lightness, L* (as value increases from 0-100%), redness to greenness, a* (60 to-60 positive to negative values, respectively), and Y* (luminance to luminosity). To calibrate the instrument, conventional black and white tiles were used. The Hunter L, a, b, and Y values for the sausage samples were recorded after they were positioned beneath the light source. Three measurements were made for each sample.

2.6 Determination of Texture

To identify the sausage's textural parameters, the texture was examined using Texture Analyzer. Using computer software connected to the texture analyzer, test findings were plotted into a graph along with the following parameters: The resulting force/deformation curve was assessed for hardness, springiness, cohesiveness, chewiness, and gumminess (Briones-Labarca *et. al.,* 2012).

2.7 Determination of Water Holding Capacity (WHC)

By using the centrifugation technique (Jauregui *et.al.,* 1981) the water holding capacity of chicken sausage was determined. Each sausage sample weighed about 2.5g, and it was enveloped in filter paper (Whatman-3) before being centrifuged at 3,000 rpm for 20 minutes. The methods outlined here were used to calculate water holding capacity.

2.8 Sensory Evaluation

Texture, flavour, taste, color, tenderness, juiciness, and overall acceptability of sensory attributes were assessed for each sample. The sensory evaluation was done by 10 panelists using a 9-point scale from outstanding (score=9) to very bad (score=1) Hedonic rating tests. Before the sensory test, 300g of each sample of chicken sausage is pan fried with 10 ml of vegetable oil in a cooking pan for about 3 minutes each. For sensory evaluation, 30g of each sample was given to the panelist along with the sensory evaluation score card.

2.9 Estimation of storage life of chicken sausage

Boiled chicken sausages were packed in vacuum-packed pouch and stored in deep refrigerator. Protein, moisture content, peroxide value, water holding capacity (WHC) and pH were measured in each of the samples at 0, 7, 14, 21, and 28 days of storage time. A triplet samples of the chicken sausage were tested for the test mentioned above for the study of storage life of chicken sausage.

2.10 Statistical Analysis

Using a 9 Point Hedonic test, a trained group of 10 judges evaluated the sausage samples for texture, flavour, taste, colour, tenderness, juiciness, and overall acceptability. The data was applied to a two-way analysis of variance (ANOVA) in Microsoft Excel sheet version 365 at a 5% significance level to investigate the variations in the quality parameters during storage.

3. Results and Discussion

The sausage was prepared from the chicken (breast part), fat (chicken skin), corn starch, spices, and other local herbs by boiling at 80 ºC for 20 mins. The chicken skin and CSP was used in the level of 30, 40, 50% and 5, 10, and 15 % respectively. The impact of fat and corn starch (binder) used on chicken sausage quality characteristics like texture, colour, water holding capacity (WHC), fat, and sensory parameters (overall acceptability) have been studied as described below.

3.1 Impact of fat-corn starch powder composition on quality characteristics of the chicken sausage

3.1.1 Impact of fat-corn starch powder composition on texture parameters

For all the parameters, the textural profile was evaluated among the samples, as shown in Table 1. Numerous processing factors, such as the kind and quantity of materials, additives, heat treatment, and equipment employed, have an impact on texture profiles. According to previous research (Muhamed *et.al*., 2016), who claimed that the increased hardness of sausages is caused by the raised in the level of starch, and in this research also the hardness of the chicken sausage increases as corn starch level increases and ranges from 30.25 to 33.19 N (Table 1). The results of a statistical analysis of hardness showed that, at the 5% level of significance, the amounts of fat 30%, 40%, and corn starch have no significant impact on the hardness of chicken sausage. However, as shown in Table 1, at 50% fat and 5% corn starch composition of the chicken sausage led to a significant loss in hardness. Fat aids in enhancing taste and suppleness while reducing hardness. The cohesiveness and springiness of the chicken sausage increased as the fat level increased from 30-50% and ranged from 0.08 to 0.16 and 2.63 to 3.54 mm respectively. And the other two texture parameters viz., chewiness and gumminess decreased as the level of fat increases from 30-50% and ranged from 1.93 to 2.11 kgf mm and 0.41 to 0.45 kgf respectively. However, there was no significant difference ($p>0.5$) recorded in all the textural parameters of the chicken sausages with respect to the different treatments.

3.1.2 Impact of fat-corn starch powder composition on color parameters

The color plays a key impact in the snack industry and in consumer acceptance (Nawaz *et.al.,* 2020). The color values "L" and "b" climbed when levels of fat and corn starch powder rose from 53.9 to 61.83 and 20.16 to 23.51, respectively, according to Table 2, while color value "a" declined as levels of fat and corn starch rose from 4.81 to 5.89. The higher value of "L" and "b" may be explained by the white colour of corn starch powder, which adds to the lightness of the chicken sausage. The value of "a" has decreased because fat and the corn starch powder, which act as a binding agent and a flavor enhancer, respectively, have been added. Statistical analysis revealed that the amount of fat ($p<0.05$) and the amount of corn starch powder ($p<0.05$) significantly affected the color values “L” and “a” in the chicken sausage, as shown in Table 2.

3.1.3 Impact of fat-corn starch powder composition on Water Holding Capacity (WHC)

One of the key qualities of sausage and other meat products is their capacity to retain moisture and other liquids both before and after processing (Sharoba, 2009). The examination into the impacts of adding CSP on the physical characteristics of cooked chicken sausage samples, including

Table 1. Impact of fat-corn starch powder composition on texture parameters

Parameter	Fat level (%)	Corn Starch level (%)			Statistical P values
		5	10	15	
Hardness (N)	30	31.33±0.05	31.67±0.12	33.19±0.13	Fat level (p=0.067) Corn starch level (p=0.058)
	40	30.87±0.11	31.50±0.02	32.87±0.06	
	50	30.25±0.02	31.25±0.07	31.61±0.02	
Cohesiveness	30	0.08±0.12	0.08±0.10	0.09±0.06	Fat level (p=0.056) Corn starch level (p=0.053)
	40	0.10±0.09	0.12±0.03	0.12±0.03	
	50	0.13±0.05	0.16±0.11	0.16±0.04	
Springiness (mm)	30	2.72±0.14	2.69±0.02	2.63 ±0.06	Fat level (p=0.052) Corn starch level (p=0.060)
	40	2.94±0.04	2.77±0.03	2.71±0.02	
	50	3.54±0.07	3.27±0.02	2.87±0.04	
Chewiness (kgf mm)	30	1.99±0.06	2.10±0.02	2.11±0.03	Fat level (p=0.056) Corn starch level (p=0.053)
	40	1.96±0.14	2.07±0.01	2.07±0.07	
	50	1.93±0.03	1.98±0.04	2.00±0.11	
Gumminess (kgf)	30	0.43±0.02	0.44±0.18	0.45±0.06	Fat level (p=0.056) Corn starch level (p=0.053)
	40	0.42±0.12	0.43±0.04	0.43±0.15	
	50	0.41±0.03	0.42±0.02	0.42±0.09	

Table 2. Impact of fat-corn starch powder composition on colour parameters

Parameter	Fat level (%)	Corn Starch level (%)			Statistical P values
		5	10	15	
Colour – L	30	53.90±0.40	55.09±0.32	59.82±0.17	Fat level (p=0.045) Corn starch level (p=0.032)
	40	54.30±0.35	56.53±0.50	60.76±0.48	
	50	55.30±0.82	57.78±0.19	61.83±0.14	
Colour - a	30	5.89±0.40	5.73±0.10	5.66±0.08	Fat level (p=0.035) Corn starch level (p=0.062)
	40	5.72±0.18	5.69±0.90	5.43±0.17	
	50	5.31±0.21	5.08±0.12	4.81±0.40	
Colour - b	30	21.20±0.20	21.22±0.21	20.16±0.33	Fat level (p=0.67) Corn starch level (p=0.53)
	40	21.41±0.16	21.82±0.19	21.19±0.12	
	50	23.51±0.13	22.48±0.09	21.52±0.42	

their water holding capacity (WHC), is presented in Table 3. The WHC of the different chicken sausage samples varied between 6.35 to 9.63 cm2/0.3g, with the 15% corn starch powder-containing chicken sausage having the greatest WHC. The addition of varied quantities of corn starch powder had no appreciable impact on the WHC of the produced chicken sausage samples ($p>0.05$). The WHC of the sausage marginally rose with a rise in the proportion of the corn starch powder (5%, 10%, and 15%), which may be attributed to the absorbency characteristics of the corn starch powder that was incorporated during the manufacture of the chicken sausage. To prevent the sausage's components from disintegrating while being consumed, addition of corn starch powder was primarily intended to guarantee that they were correctly held together.

Table 3. Impact of fat-binder composition on quality parameters of chicken sausage

Parameter	Fat level (%)	Corn Starch level (%)			Statistical P values
		5	10	15	
Water holding capacity (WHC) $cm^2/0.3g$	30	7.51±0.40	8.33±0.32	9.63±0.17	Fat level (p=0.058) Corn starch level (p=0.052)
	40	6.87±0.35	7.63±0.50	8.76±0.48	
	50	6.35±0.82	6.92±0.19	7.82±0.14	
Overall Acceptability	30	6.60±0.40	6.90±0.10	7.20±0.08	Fat level (p=0.035) Corn starch level (p=0.042)
	40	6.80±0.18	7.20±0.90	7.50±0.17	
	50	7.20±0.21	7.50±0.12	7.80±0.40	
Fat content (%)	30	20.23±0.21	21.54±0.08	22.93±0.22	Fat level (p=0.040) Corn starch level (p=0.023)
	40	25.93±0.01	26.81±0.73	26.69±0.31	
	50	32.56±0.40	31.75±0.36	30.78±0.80	

3.1.4 Impact of fat-corn starch powder composition on fat content

When preparing meat, meat products, or sausages of various types, fat is a crucial food ingredient. It helps to provide energy and is essential for improving the flavor of food products, particularly meat and meat products like sausages. Table 3 shows that as more chicken skin was used in the preparation of the chicken sausage samples, the fat content of the resulting sausages rose. Similar, findings were reported (El-Nashi *et.al.,* 2015). Table 3 shows that the fat percentage of the various sausage samples ranged from 20.23 to 32.56%, with the sample containing 50% chicken skin having the highest fat content at 32.56%. Statistical analysis showed that the amount of fat ($p<0.05$) and the amount of corn starch powder ($p<0.05$) significantly affected the amount of fat in the chicken sausage, as shown in Table 3.

3.1.5 Impact of fat-corn starch powder composition on overall acceptability

The trained panelists' assessment of the appearance, color, taste, tenderness, juiciness, and odor of the various chicken sausage samples were presented which determines whether the chicken sausage is generally deemed to be acceptable. It was found that the chicken sausage scored between 6.6 and 7.8 on the acceptability scale overall. Furthermore, Table 3 shows that, with products manufactured at a 50% level of fat and a 15% level of corn starch powder, the overall acceptance of the chicken sausage increased.

Table 3 also shows that statistical analysis showed that the percentage of fat ($p<0.05$) and the percentage of corn starch powder ($p<0.05$) had an appreciable impact on the overall acceptability of the chicken sausage. The panelist concluded that the colour was within the permitted limit, and that the taste, juiciness, and aroma and flavour from the local herbs incorporated in the chicken sausage may have contributed to its acceptance despite the color change.

3.2 Impact of storage time on quality characteristics of the chicken sausage.

Protein content, moisture content, peroxide value, water holding capacity (WHC) and pH of the chicken sausage changed significantly over a period of 28 days of storage time, as described in the subheadings below.

3.2.1 Protein content as affected by the storage time.

The amount of protein in a food product is a good indicator of its nutritional value. Chicken is the most crucial food ingredient in terms of nutrition because it is marketed as an excellent source of protein for those following a non-vegetarian diet. The greater crude protein content of the chicken sausage found in this study may be attributable to the protein found in the corn starch powder that was used as a binder and added at a level of 5–15% to make the chicken sausage. The crude protein content of partially cooked chicken sausages was substantially higher than that of raw chicken sausages, regardless of the length of storage. This is explained by the fact that the partially cooked chicken sausage had less moisture content, which led to an increase in dry matter content and a larger percentage of crude protein. In studies using items including cooked meat, studies were conducted in beef patties (Serdaroglu, 2006) and chicken meat patties (Singh & Verma, 2000). Regardless of the type of meat utilized, up to 7 days of refrigerated storage of chicken meat sausages resulted in a substantial increase in the mean percent protein content of the chicken sausages. However, longer storage periods of up to 28 days have led to a steady decline in the mean percent crude protein. The large drop in moisture content of the sausages during storage, which was represented in a greater % crude protein content, may be the cause of the progressive and significant increase in crude protein content following storage up to 7 days. As

the length of refrigeration increased, there was a rise in the percentage of protein content in chicken meat sausage. Similar results were concluded by some researchers (Rao & Reddy, 2000). In the present study, protein deterioration in the stored chicken sausage sample may be the cause of the later stage of storage's drop in percent crude protein content from 15.67-15.14%. This is related to the simultaneous rise in pH and fall in the ability of chicken meat sausages to hold water when being refrigerated for up to 28 days. These results are similar with those made in chevron patties (Rajkumar *et.al.,* 2004) and chicken sausages (Vijayalakshmi, 1995), respectively.

3.2.2 Moisture content as affected by the storage time.

The quality and keeping quality of emulsion sausages are influenced by their moisture content. The moisture level of the chicken meat sausage formulation in the current investigation displays a decreasing tendency as corn starch powder added to the chicken sausage increases by 5%, 10%, and 15%. This might be caused by the added binder's low moisture content. The addition of an extender causes a decrease in moisture content in Cabrito smoked sausages (Cosenza *et.al.,* 2003). Regardless of the type of meat utilized, chicken meat sausages' general mean percent moisture content dropped throughout the course of 28 days in refrigeration. This could be caused by the evaporation of moisture from the meat in the chiller as well as the loss of drip fluid in the course of storage (Arief *et.al.,* 1989). The current study's observation of a declining percent moisture from 55.18 to 54.38% during refrigeration is consistent with earlier research on duck patties (Biswas *et.al.,* 2011), loaves made from chicken meat (Rao, 1997), and buffalo meat emulsion sausages (Abdolghafour & Saghir, 2014).

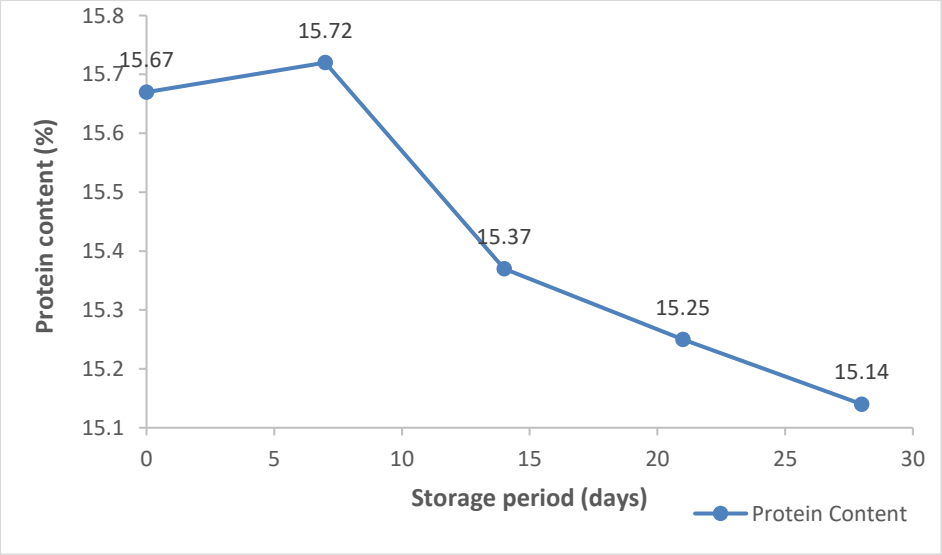

Figure 1. Protein content as affected by the storage time.

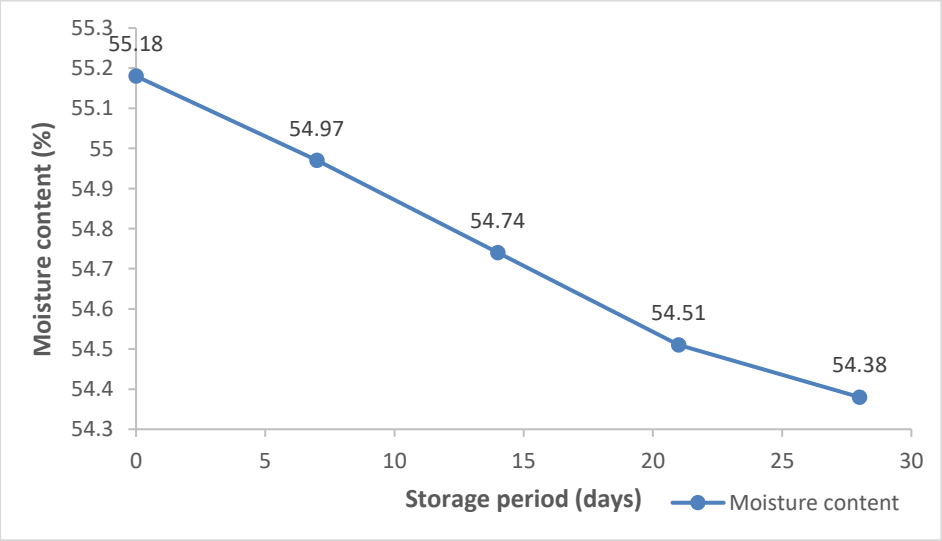

Figure 2. Moisture content as affected by the storage time.

3.2.3 Peroxide value as affected by the storage time.

Fats and oils can be evaluated for their peroxide value to determine how long they were rancid during storage. A food's smells and unpleasant flavors are brought on by the autoxidation of its lipids and oils. To gauge the level of deterioration during storage, one might look at the peroxide content in fat and oil. Fig. 3 depicts the rise in peroxide levels of vacuum-packaged chicken sausage during the course of the 28 days of storage time, from 2.13 to 4.05 meq/kg. However, the difference was not statistically significant at the 5% level of significance. Similar findings were also reported (Raleng *et.al,* 2019). On the other hand, chicken sausage that had been vacuum-sealed showed an increase in peroxide value when more time had passed ($p < 0.05$). The FAO's acceptable standards for peroxide (10 meq/kg) were still met even after 28 days of storage.

3.2.4 Water holding capacity (WHC) as affected by the storage time.

One crucial quality of sausage and other pork products is their capacity to retain moisture and other liquids both before and after processing. Along with eating quality, juiciness, thawing drip, cooking loss and tenderness, the water holding capacity (WHC) of meat and meat products is one of its most crucial characteristics. In comparison to the 5% and 10% corn starch powder levels, the chicken sausage sample with 15% corn starch powder shows the highest WHC (Fig.4). As storage time increased from 0-28 days, it was observed that the WHC of every sausage gradually reduced. Protein denaturation and/or aggregation during frozen storage may be used to explain this. These findings are in agreement with those reported by other scientists (Madkour *et.al.,* 2000; Gibriel *et.al.,* 2007).

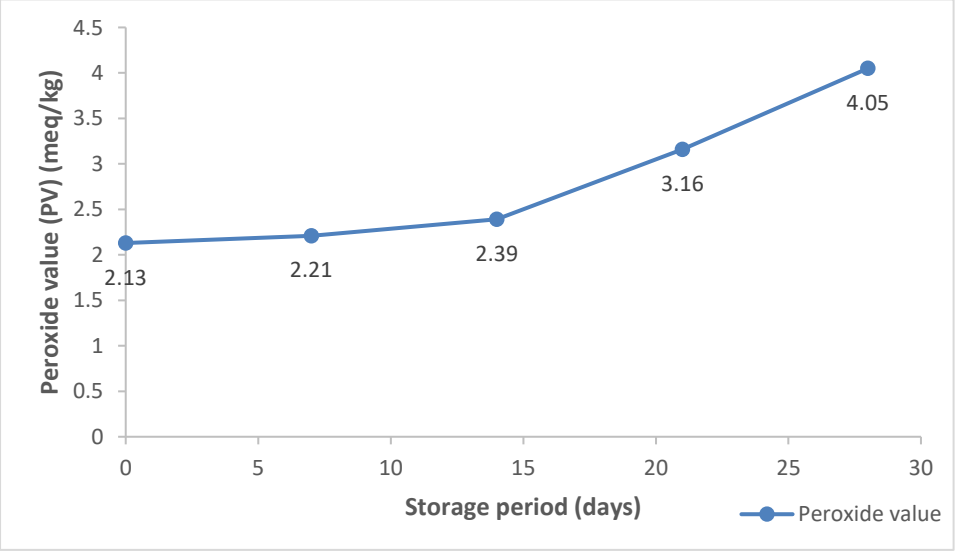

Figure 3. Peroxide value as affected by the storage time.

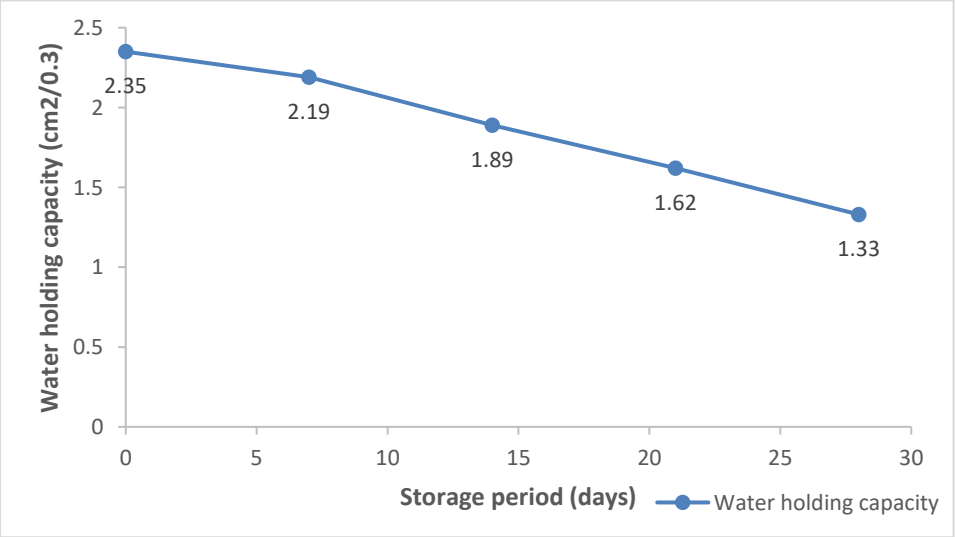

Figure 4. Water holding capacity (WHC) as affected by the storage time.

3.2.5 pH as affected by the storage time.

In general, it was observed that as the storage period was extended from 0 to 28 days, the pH value also increased (Fig.5). The overall trend for the effects of increasing the corn starch powder from 5-15% was also accompanied by an increase in pH value. Similar findings were also reported (Sharoba, 2009). When proteins break down, small amounts of basic chemicals like ammonia are produced, which may be the cause of pH variations that are related to an organism's activity. The pH of chicken sausage increased at a rate that was deemed safe for human consumption under refrigeration for 28 days of storage time.

4. Conclusion

The scope of chicken as a source of protein supplement fortified with local herbs has been studied. Consumption of chicken can be increased by developing a variety of processed chicken products, which can be termed as "transforming the raw chicken into value-added, easy to prepare and convenient food" like sausages. The WHC is affected by the level of the corn starch as the corn level is increased the WHC increases. The hardness of the chicken sausage is affected by the level of corn starch as the level of corn starch is increased the hardness increases whereas the hardness is decreased as the level of the fat increases and decreased best at 50 fat and 5% corn starch powder which contributes to the softening of the sausage. The local herbs had an impact on the flavour, aroma and overall acceptability of the chicken sausage and had little effect on the color parameters. The quality characteristics in the storage study indicate and imply that the chicken sausage is safe to eat after 28 days of storage in a vacuum packed stored in refrigeration without any deterioration.

5. Declarations

Authors Contribution:

Angam Raleng: Conception and design of the research work, execution, and monitoring of the research work, wrote the research paper, collection of the data, interpretation of the data, prepare the tables and figures, final drafting of the research work and submitting the paper to the journal.

Saroj Kumar Behera: Collecting of the review papers, monitoring of the research work, helping in writing, and editing of the research work.

Tini Thangjam: execution of the research work, collection of the review papers, help in writing of the research work.

Pretty Moirangthem: execution of the research work, collection of the review papers, help in writing of the research work.

Seram Bandana: execution of the research work, collection of the review papers, help in writing of the research work.

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Data availability statement: The authors agree to produce the data which is related to this research manuscript as when required or on demand.

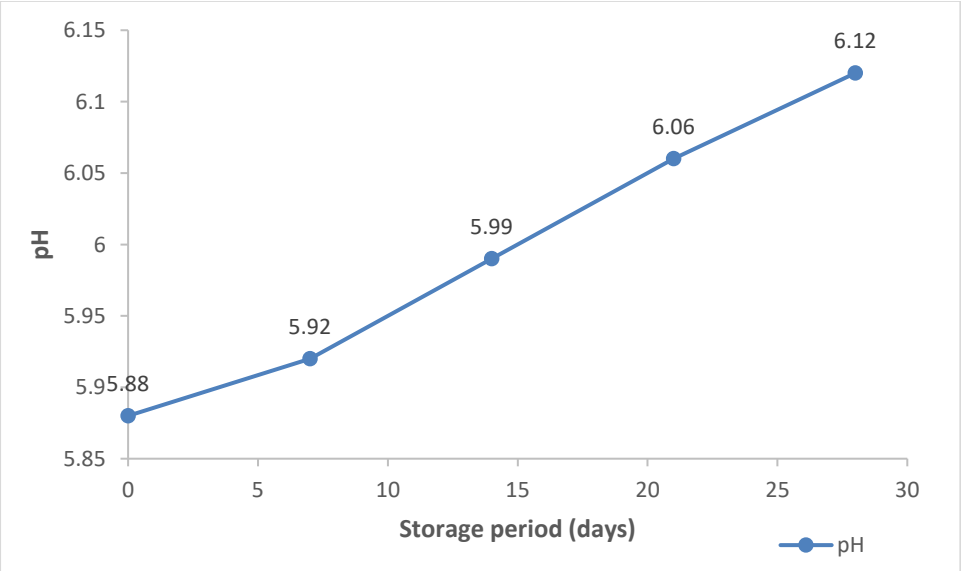

Figure 5. pH as affected by the storage time.

6. References

A.O.A.C. (2000): Official methods of analysis. Association of Official Analytical, Chemist 16th ed., Washington, D.C.U.S.A.

Abdolghafour B, Saghir A (2014). Development in sausage production and practices - A review, Journal Meat Science and Technology 2(3): 40-50.

Arief MA, Reddy KP, Reddy VR (1989). Influence of packaging materials and storage periods on certain organoleptic characteristics of broiler cut up parts. Kerala Journal of Veterinary Science 20:107-114.

Biswas S, Chakraborty A, Patra G, Dhargupta A (2011). Quality and acceptability of duck patties stored at ambient and refrigeration temperature. International Journal of Livestock Production 1:1-6.

Briones Labarca V, Perez Won M, Zamarca M, Aguilera R, Tabilo MG (2012). Effects of high hydrostatic pressure on microstructure, texture, colour and biochemical changes of red abalone (*Haliotis rufecens*) during cold storage time. Innovative Food Science and Emerging Technology 13: 42-50.

Cosenza GH, Williams SK, Johnson DD, Sims C, Msgowan CH (2003). Development and evaluation of a cabrito smoked sausage product. Meat Science 64:119-124.

El-Nashi HB, Fattah AFBKA, Rahman NRA, El-Razik MMA (2015). Quality characteristics of beef sausage containing pomegranate peels during refrigerated storage. Annals of Agricultural Science 60(2): 403-412.

Gibriel AY, Ebeid HM, Khalil HI, Abdel-Fattah AA (2007). Application of Monascus purpureus pigments produces using some food industry wastes in beef sausage manufacture. Egypt Journal of Food Science 35:27-45.

Jaureigui CA, Regenstein JM, Baker RC (1981). A simple centrifuge method for measuring expressible moisture, a water binding property of muscle foods. Journal of Food Science 46: 1271-1273.

Madkour MH, Ebeid HM, Ashour EZ, Gibriel AY (2000). Production and use of Monascus purpureus as colouring agent in beef burger. Annals in Agricultural Science, Moshtohor 38(1): 317.

Mohamed HM, Emara M, Nouman TM (2016). Effect of cooking temperatures on characteristics and microstructure of camel meat emulsion sausage. Journal of Science in Food and Agriculture 96(9): 2990-2997.

Nawaz A, Li E, Irshad S, Xiong Z, Xiong H, Shahbaz H M, Siddique F (2020). Valorization of fisheries by-products: challenges and technical concerns to food industry. Trends in Food Science and Technology. 99(34-43).

Rajkumar V, Agnihotri MK, Sharma N (2004). Quality and shelf life of vacuum and aerobic packed chevon patties under refrigeration. Asian-Australian Journal of Animal Science 17(4): 548-553.

Raleng A, Singh A, Chavan P, Attkan A, Singh B (2019). Standardization of deep-frying process and their effects on storage stability of pineapple pomace powder- incorporated rice-based extruded product. Journal of Food Processing and Preservation .10.1111/jfpp.13950

Rao BJ, Reddy KP (2000). Influence of binders and refrigerated storage on the quality of chicken meat loaves. Indian Journal of Poultry Science 35(3):302-305.

Rao JB (1997). Studies on the preparation of chicken loaves incorporating partially cooked chicken meat and binders. Dissertation, Acharya N.G. Ranga Agricultural University, Hyderabad.

Serdaroglu M (2006). The characteristics of beef patties containing different levels of fat and oat flour. International Journal of Food Science and Technology 41 (2):147-153.

Sharoba AM (2009). Quality attributes of sausage substituted by different levels of whole amaranth meal. Annals of Agricultural Science, Moshtohor 47(2): 105-120.

Singh RP, Verma SS (2000). Physico-chemical and sensory quality of chicken patties as influenced by extender and packaging materials. Indian Journal of Poultry Science 35(1):85-88.

Verbeke W, Perez-Cueto FJA, de Barcellos MD, Krystallis, Grunert KG (2010). European citizen and consumer attitudes and preferences regarding beef and fork. Meat Science, 84: 284-292.

Vijayalakshmi K (1995). Studies on the utility of partially cooked and uncooked spent chicken meat for preparation of sausages. Dissertation, Agricultural University, Hyderabad.

Xiong YL (2012). Nonmeat ingredients and additives, In Handbook of Meat and Meat. Processing (Eds. By Hui YH et al.). CRC press,573-588.

Yadav SK, Tanwar VK, Sharma JK, Yadav S (2013). Effect of added soy protein on physico-chemical properties of chevon patties. Journal of Meat Science and Technology, 1(1): 35-39.