DR-1944
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RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume Issue : ()

Development of Shelf Stable Chitterlings Pickle Incorporated with Natural Acidulant

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10.18805/ajdfr.DR-1944

ABSTRACT

Background: Intestine of pigs (chitterling) is one of the important edible offal with substantial yield and accounts for 1.8% of the slaughter weight. At present its utilization as direct consumption is limited only to some economically weaker section of population. Therefore the present study was undertaken to develop a shelf stable chitterling pickle recipe incorporated with fermented bamboo shoot (FBS) and lemon juice as natural acidulant.

Methods: Freshly collected intestines of pig were washed, pressure cooked, cut into 3 to 4 cm^3 and deep fried. Spices and condiments were fried separately then mixed with the fried chitterlings along with FBS and lemon juice to prepare the shelf stable chitterling pickle. The pickles were studied for various parameters such as physico-chemical, microbial and sensory attributes.

Result: Our study showed significantly ($p<0.05$) higher pH, product yield and moisture content in the chitterling pickle added with FBS and lemon juice. Protein and fat content did not differ significantly. No adverse effects were noted on hedonic score for appearance, flavor, juiciness, texture, saltiness, sourness and overall acceptability up to 12 days of storage at ambient temperature. The overall acceptability of chitterling pickle with FBS and lemon juice was significantly ($p<0.05$) higher as compared to control. Therefore, it could be concluded that highly acceptable shelf stable pickle can be prepared from intestine of pig with substantial value addition to the by-products.

Key words: Chitterling pickle, Fermented bamboo shoot (FBS), Lemon juice, Shelf stability.

INTRODUCTION

Meat by-product may constitute valuable resource if they are utilized properly to produce value added products (Toldra and Reig, 2011). Small intestine of pigs (chitterlings) is one of the important edible offal with substantial yield and it accounts for 1.8% of slaughter weight in pig. Pork products are popular and versatile meat product with greater acceptability all over the world but on the contrary its by-products namely the intestine and stomach are not being properly utilized. In most of the Indian condition the materials is being rendered along with other by-products for preparation of meat meal or meat-cum-bone meal. At present edible use of pig intestine is limited only to some economically weaker section of population who use it for direct consumption procuring at lower price compare to skeletal muscle meat. Pickling increase shelf-life and retain soft moist texture and are stable at ambient temperature. Development of value added product using pig intestine is also limited because of its inherent toughness due to high collagen content, off odor, poor functional properties and some religious taboos. Intestine and stomach of pig offers a good potential for development of value added product especially in the North-Eastern part of India due to its high demand of pork product and relaxation on religious taboos among the population. Shelf stable meat products could be processed by adjusting hurdles like water activity, pH, creating anaerobic conditions and using food preservatives *etc*. and can be stored without refrigeration (Leistner and Rodel, 1976 and Alakomi *et al*., 2002). Bamboo shoot is available in almost all parts of North-East, India and FBS are widely consumed by many tribal communities of the region with varied preparation method. Fermentation of bamboo shoots not only makes it palatable in terms of flavor, aroma, texture and appearance but also makes it highly nutritious and extends its shelf life because of the action of lactic acid bacteria making the product acidic and good for digestion (Singhal *et al.* 2017). Due to its high perishability and lack of cold chain facilities in developing countries like India, it is very much imperative to develop shelf stable meat products with good sensory attributes and better stability at ambient temperature. Since available literature shows not much work has been done on intestine of pigs for edible purpose and value addition, the present study was carried out to develop and standardize chitterling pickle by hurdle technology treated with FBS and lemon juice as natural

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How to cite this article: Pame, K., Borah, S., Daimary, B., Kakoty, K., Gogoi, A. and Saikia, R.R. (2022). Development of Shelf Stable Chitterlings Pickle Incorporated with Natural Acidulant. Asian Journal of Dairy and Food Research. DOI: 10.18805/ajdfr.DR-1944.

Submitted: 23-04-2022 **Accepted:** 31-10-2022 **Online:** 11-11-2022

acidulant on the physico-chemical parameters, microbial qualities and sensory attributes.

MATERIALS AND METHODS

Intestines were collected from pig slaughtered hygienically at Instructional Farm Complex, Lakhimpur College of Veterinary Science, Assam Agriculture University, Joyhing. Intestinal contents and all external fats and fascia were trimmed off and stored at 4±1°C for 24 hours for conditioning, then frozen until use. FBS and other non-meat ingredients were procured from local market. Mustard oil (*dhara*) was used for frying of spice mix and condiments. The condiments and green chillies were prepared by manual chopping. The control formulation was standardized after repeated pilot study as per the procedure shown in Fig 1. In all formulation, lemon juice was incorporated and fermented bamboo shoot mixed with other ingredient in treatment (Table 1). The pH was determined as per procedure of Troutt *et al*., (1992). The water activity of the chitterling pickle samples were measured in chamber of Labswift a_w meter (Novasina, Switzerland). Cooking yield per cent was determined by calculating the weight differences for sample before and after preparation according to Berry and Wergin, (1992). The moisture, protein and ether extract per cent were estimated as per AOAC, (1990). Microbiological analysis (Total Plate Count, yeast and mold count, *Coliform* count and *Salmonella* detection,) was carried out according to American Public Health Association, (1984) on the day of preparation, 7th and on the 12th day of storage at ambient temperature. Sensory evaluation of the shelf stable chitterling pickle was conducted using 8-point Hedonic Scale (8= Extremely acceptable; 1= Extremely undesirable) by semi trained taste panellists as per AMSA, 1983 on the day of preparation, 3rd, 5th, 7th, 9th, 11th and 12th day of storage. The average of the individual scores was taken as the score for the particular attribute. The cost of production was calculated based on the prevailing market cost of the raw materials and various ingredients used in the formulation. The data were statistically analysed as per Snedecor and Cochran, (1994) using SPSS software version 21.0.

RESULTS AND DISCUSSION

The physico-chemical properties of the developed chitterling pickle incorporated with FBS and lemon juice as natural acidulates are presented in the Table 2. The pH of the pickle sample on the day of preparation was found to be 3.75±0.06 for control, 4.78±0.09 for T1 and 3.66±0.09 for T2 respectively. The pH value was significantly ($p<0.05$) higher for the chitterling pickle sample treated with 30 per cent FBS. The water activity (a_w) did not differ significantly and was found to be 0.90 (C), 0.98 (T1) and 0.96 (T2) respectively

Table 1: Formulation of chitterling pickle.

Ingredients	C (control) (%)	T (treatment) 1	T (treatment) 2
Intestine of pig	100	100	100
Refined oil	25	25	25
Mustard oil	5	5	5
Garlic	15	15	15
Ginger	15	15	15
Dried red chilli powder	5	5	5
Mustard seed (powder form)	2.5	2.5	2.5
Turmeric powder	1	1	1
Salt	3	3	3
Lemon juice	20	20	20
FBS	-	30	-

*Above the quantity of the formulation added over and above treatment (control) chitterling pickle.

C- (without FBS and lemon juice), T1- (C+ 30% FBS and 20% lemon juice). T2- (C+20% lemon juice).

Collection, cleaning (with salt) and trimming off the facia and fats from intestine

↓

Pressure cooked at 15 lb pressure for 15–18 min.

↓

Drained off excess fluid

↓

Cut in to small uniform (3-4 cm^3) pieces

↓

The chitterling pieces were fried in mustard oil until the pieces developed brownish colour.

↓

Fry the spices and condiments separately in mustard oil for 2-3 min.

↓

Addition of FBS and lemon juice

↓

Mix properly under low temperature for some time

↓

Cool to room temperature

↓

Packaging in food grade HDPE and glass container.

Fig 1: Preparation of chitterlings pickle.

and any food that has a_w greater than 0.85 and a finished equilibrium pH of 4.6 or below can be categorised as "pickles" or "pickled" food (Barron 2007). The protein, ether extract, ash and moisture content showed no significant difference ($p<0.05$) between all the chitterling pickle samples. These results were in accordance with Maiti *et al*. (2009) who reported that pickling had no significant effect on proximate composition of pickle prepared from chicken gizzard and goat heart. However dietary fibre of T1 was significantly ($p<0.05$) higher than control and T2, which might be due to the higher fibre content in FBS which was incorporated in the T1 over and above the control formulation. The results pertaining to changes in the sensory attributes of the developed chitterling pickle evaluated by the panel members (Table 5) revealed that the semi trained panellists liked all the products equally on the day of preparation however sensory score decreased with the increase in storage period. The addition of 30 per cent FBS significantly ($p<0.05$) increased the flavour, juiciness, sourness and overall acceptability compared to control and pickle sample without FBS but with 20% lemon juice. The overall acceptability of T1 is significantly ($p<0.05$) higher than control and T2 during all days of storage, which might be due to the higher score in juiciness, sourness and enhanced flavour due to the addition of 30 per cent FBS. The average effect of sensory attributes (0^{th} to 12^{th} days) of storage (Fig 2) revealed that there is no significant difference in appearance and colour however chitterling pickle with FBS is significantly ($p<0.05$) higher than control and T2 with respect to juiciness, sourness and overall acceptability. Similarly pork pickle incorporated with fermented bamboo shoot powder was more preferred over pickle with fermented bamboo shoot extract and without fermented bamboo shoot evaluated in greater Guwahati area of Assam (Hazarika *et al.,* 2014). The colour characteristics of the control and treatment were measured objectively in terms of L*, a* and b* values and the results are presented in (Table 3). The statistical analysis of the data revealed that there was no significant difference between control and T2 for lightness (L*) and yellowness (b*) values. However colour parameter redness (a*) value of T1 (with FBS) was significantly ($p<0.05$) lower compared to control and T2, which might be due to the addition of FBS. The effect of storage on microbial quality of shelf stable chitterling pickle (Table 4) showed that total plate count (TPC) and yeast and mold count is much low on the day of preparation which could be due to microbial destruction by pressure cooking and pan-frying of the chitterling. The bactericidal action of lemon juice is also long known. However TPC and yeast and mold count were significantly ($p<0.05$) increased in all the samples during the storage period and the increase was significantly ($p<0.05$) more pronounced in the control and T2 (with acidulant but without FBS) than T1 (with FBS). However *Coliform* and *Salmonella* spp. was not detected during the storage period. The increased in yeast and mold count during storage might be due to more moisture content due to the addition of FBS in pickle might have favoured the growth of yeast and mold. Similar increase in the microbial count was reported by Rajbanshi *et al,*. (2016) in chicken pickle incorporated with acetic acid. The production cost of developed chitterling pickle was calculated at Rs. 180.00

Table 2: Effect of FBS and lemon juice on the physico-chemical characteristics and proximate composition of developed chitterling pickle (0^{th} day).

Parameters	C	T1	T2
pH	$3.75^{a}\pm0.06$	$4.78^{b}\pm0.09$	$3.66^{a}\pm0.09$
a_w	$0.906^{a}\pm0.03$	$0.986^{a}\pm0.03$	$0.966^{a}\pm0.03$
Moisture (%)	$52.31^{a}\pm0.04$	$52.58^{a}\pm0.07$	$52.48^{a}\pm0.05$
Protein (%)	$22.24^{a}\pm0.36$	$22.24^{a}\pm0.36$	$22.79^{a}\pm0.33$
Ether extract (%)	$19.14^{a}\pm0.31$	$19.25^{a}\pm0.22$	$19.95^{a}\pm0.22$
Dietary fibre	$2.70^{a}\pm0.02$	$3.10^{b}\pm0.03$	$2.20^{a}\pm0.08$
Ash	$4.13^{a}\pm0.16$	$4.93^{a}\pm0.21$	$4.73^{a}\pm0.25$

Mean±SE with same superscripts in a row does not differ significantly ($p<0.05$).

C- Control (without FBS and lemon juice), T1- (C+ 30% FBS and 20% lemon juice). T2- (C+20% lemon juice).

Table 3: Effect on colour (Hunter L*a*b*) on chitterling pickle.

Parameter	C	T1	T2
L* (lightness)	$32.81^{a}\pm0.50$	$31.24^{a}\pm0.55$	$31.09^{a}\pm0.48$
a* (redness)	5.68 ± 0.20^{a}	3.52 ± 0.18^{b}	5.35 ± 0.48^{a}
b* (yellowness)	$18.01^{a}\pm0.39$	$18.60^{a}\pm0.36$	$18.08^{a}\pm0.29$

Mean±SE with same superscripts in a row does not differ significantly ($p<0.05$).

C- Control (without FBS and lemon juice), T1- (C+ 30% FBS and 20% lemon juice). T2- (C+20% lemon juice).

Table 4: Effect of storage on microbial quality of shelf stable chitterling pickle.

Days	Control	T1	T2
Total plate count (log cfu/g)			
0^{th}	$1.83^{a}\pm0.34$	$1.12^{a}\pm0.73$	$1.56^{a}\pm0.73$
7^{th}	2.18 ± 0.52^{a}	1.98 ± 0.54^{b}	2.76 ± 0.72^{a}
12^{th}	4.23 ± 0.52^{a}	2.14 ± 0.62^{b}	3.23 ± 0.62^{c}
Yeast and Mold (log cfu/g)			
0^{th}	$0.92^{a}\pm0.13$	0.12 ± 0.90	$0.87^{a}\pm0.62$
7^{th}	1.77 ± 0.62^{a}	0.87 ± 0.72^{b}	1.23 ± 0.21^{a}
12^{th}	2.92 ± 0.52^{a}	1.42 ± 0.63^{b}	2.23 ± 0.52^{a}
Coliform			
0^{th}	ND	ND	ND
12^{th}	ND	ND	ND
***Salmonella* spp.**			
0^{th}	ND	ND	ND
12^{th}	ND	ND	

ND- Not detected.

Mean±SE with same superscripts in a row does not differ significantly ($p<0.05$).

C- Control (without FBS and lemon juice), T1- (C+30% FBS and 20% lemon juice). T2- (C+20% lemon juice).

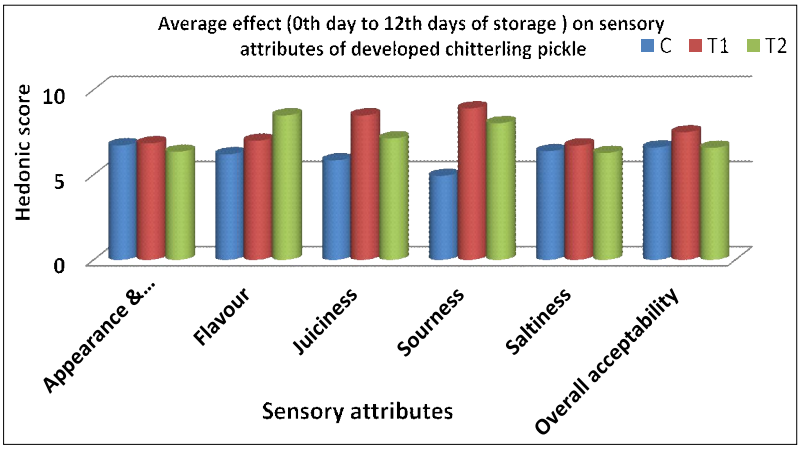

Fig 2: Average effect on sensory attributes of the developed chitterling pickle.

Table 5: Effect of storage on sensory attributes of developed chitterling pickle.

Sample	Storage period (days)						
	0th	3rd	5th	7th	9th	11th	12th
Appearance and colour							
C	7.34±0.21	6.93±0.52	7.12±0.75	6.00±0.12	6.10±0.32	6.90±0.87	6.84±0.87
T1	6.34±0.42	6.90±0.52	7.14±0.52	6.80±0.21	6.28±0.32	7.68±0.28	6.86±0.32
T2	6.27±0.35	6.23±0.53	6.42±0.52	6.42±0.42	6.35±0.62	6.32±0.42	6.32±0.42
Flavour							
C	6.24±0.42	6.24±0.52	6.25±0.62	7.52±0.62	6.26±0.52	5.26±0.62	5.72±0.87
T1	7.52±0.98	7.65±0.87	7.21±0.87	6.93±0.98	7.12±0.98	6.13±0.81	6.52±0.52
T2	7.21±0.82	7.13±0.51	7.31±0.41	6.12±0.71	6.31±0.51	6.12±0.71	5.91±0.71
Juiciness							
C	6.23±0.52	6.92±0.42	5.91±0.92	5.41±0.82	5.81±0.62	5.82±0.62	5.09±0.62
T1	8.72±0.62	8.92±0.62	8.52±0.82	7.92±0.72	8.62±0.82	8.52±0.92	8.32±0.62
T2	7.92±0.62	7.22±0.63	6.87±0.62	6.98±0.72	7.00±0.62	7.12±0.62	6.92±0.62
Sourness							
C	4.12±0.51	4.91±0.82	4.92±0.92	4.92±0.42	5.12±0.71	5.51±0.71	5.00±0.61
T1	9.42±0.51	9.12±0.42	8.29±0.82	9.92±0.23	9.23±0.12	8.12±0.98	8.32±0.26
T2	8.90±0.52	8.23±0.62	8.34±0.52	8.14±0.98	7.25±0.92	8.24±0.83	7.23±0.92
Saltiness							
C	6.26±0.62	6.27±0.51	6.71±0.82	5.96±0.97	5.76±0.82	6.92±0.51	6.84±0.87
T1	6.92±0.86	6.97±0.87	6.95±0.85	6.84±0.73	6.96±0.96	6.23±0.92	6.24±0.87
T3	6.45±0.98	6.23±0.98	6.23±0.98	6.12±0.87	6.43±0.87	6.12±0.86	6.45±0.87
Overall acceptability							
C	7.98±0.98	7.65±0.43	7.62±0.12	6.98±0.86	5.92±0.86	4.84±0.34	5.34±0.87
T1	9.07±0.67	8.13±0.74	8.45±0.98	8.24±0.87	7.35±0.98	5.07±0.87	6.23±0.87
T2	8.35±0.75	8.45±0.87	9.24±0.75	6.34±0.98	5.24±0.85	5.34±0.73	3.23±0.85

C- Control (without FBS and lemon juice), T1- (C+ 30% FBS and 20% lemon juice).
T2- (C+20% lemon juice).

per kg for control compared to Rs. 200.00 for treatment with FBS. The production cost of control and treatment shows not much difference even after addition of the FBS was due to the higher yield per cent.

CONCLUSION

Shelf stable chitterling pickle with good nutritive quality and overall acceptability can be prepared by incorporating fermented bamboo shoot and lemon juice as natural acidulant. The product can be safely stored up to 12 days at ambient temperature in PE/glass container. The microbial count was within the acceptable limits of cooked meat products. Therefore the work shows that better acceptable shelf stable pickle can be prepared from intestine of pig with substantial value addition to the materials and enhancing better returns to the pork industry.

Conflict of interest: None.

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