Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2022; 10(1): 201-211

Received: 07-11-2021
Accepted: 09-12-2021

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A comparative quality evaluation study on traditional and modified Wahan Mosdeng (Pork Vorta): An ethnic pork product of Tripura

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DOI: https://doi.org/10.22271/j.ento.2022.v10.i1c.8936

Abstract
Wahan Mosdeng is a traditional Tripuri dish, made with pork. This present study was conducted to developed an alternative form of Modified Wahan Mosdeng with a high shelf-life. Modified product was prepared by boiling the uniform 1.5 – 2 cm meat along with fatty tissue cut, in the presence of common salt, Ginger, Turmeric powder, with further addition of 1% vinegar, 2.5% solution of potassium sorbate and 75 µg/g of nisin. Prepared products were stored in refrigeration and frozen temperature separately. Different Physicochemical, microbiological, and sensory parameters were evaluated to get the differential picture between the target and the traditional product. The modified product showed significantly higher cooking yield along with low pH value in both refrigeration and frozen temperature. Collectively alternative form of Wahan Mosdeng recorded superior quality and was also highly acceptable even after 15 days of refrigeration storage and 30 days of frozen storage sample.

Keywords: Wahan Mosdeng, pH, frozen, refrigeration, pork, Tripura

Introduction
Wahan Mosdeng popularly known as Pork vorta/ *Suor Vorta* is a widely consumed meat product of Tripura, usually prepare with pork and a few condiments (Hoque and Taufique, 2019) [9]. This traditional Tripuri dish, mostly consumed in household and family functions, requires minimal ingredients for procuring, recently, it has emerged as a leading meat dish sold in small and medium sized restaurants as well as street-food vendors of Tripura. In Kokborok language, '*Wahan'* refers to pork and '*Mosdeng*' refers to 'mashed food'. The extremely low shelf-life of this product makes it strictly a freshly serve the local dish. Whereas with minute addition of natural and chemical ingredients, it is presumed to be possible to make this an easily marketable product with relatively high shelf-life. This present study was conducted to develop a modified form of Wahan Mosdeng with a comparatively high shelf-life then the traditional one.

Materials and Methods
Preparation of Wahan Mosdeng (Pork Vorta)
The pork was obtained from the freshly slaughtered large white yorkshire pig from the college farm and brought into the laboratory in a polyethylene beg and deboning was done in the laboratory and made into 1.5- 2 cm pork chunk cubes with the help of a knife. Good quality spices and condiments will be purchased from local grocery shops (Sihphir, Aizawl). Other preservatives were used from the laboratory if available or would be bought from a trustworthy supplier.

Table 1: Ingredient used during Formulation of TWM and MWM

Ingredient	TWM	MWM
Meat cut along with fatty tissue	1000 gm	1000gm
Common salt	2%	2%
Ginger	6%	6%
Turmeric Powder	-	2%
Vinegar	-	1%
Potassium Sorbet	-	2.5% solution
Nisin	-	75 ug/gm.

Traditional Wahan Mosdeng (boiled pork chunks) was prepared by the traditional method (i.e by boiling of both muscular and fatty tissue of pork and meat cut will (preferably 1..5- 2 cm in size), in the presence of common salt and ginger for 15 mins Further cooking without lid till the water evaporates).

Modified Wahan Mosdeng preparation is comparatively the same as TWM, but the slight modification was done during the preparation of MWM. i.e, by boiling the uniform 1.5 – 2 cm meat along with fatty tissue cut, in the presence of common salt, Ginger, Turmeric powder for 15 minutes and further cooking without a lid till the water evaporates. It will then be oven-dried for 1 hour. After that, 1% vinegar will be added. Then it will be dipped inside a 2.5% solution of potassium sorbate and 75 µg/g of nisin will be sprayed uniformly over the meat.

Allotment of product samples to different treatment groups

- **Treatment-1(R_1):** Traditional Wahan Mosdeng + Aerobic packaging in food graded packet + Storage in Refrigeration Temperature (4±1 °C).
- **Treatment 2(R2):** Traditional Wahan Mosdeng + Aerobic packaging in food graded packet + Storage in Frozen Temperature (-18 to-22 °C).
- **Treatment 3 (F1):** Modified Wahan Mosdeng + Aerobic packaging in food graded packet + Storage in Refrigeration Temperature (4±1 °C).
- **Treatment 4 (F2):** Modified Wahan Mosdeng + Aerobic packaging in food graded packet + Storage in Frozen Temperature (-18 to-22 °C).

Determination of the keeping-quality of Wahan Mosdeng

Physico-chemical qualities

Cooking yield

The raw weight of the product was recorded and the products were cooked as per the procedure for the product preparation. After that, Cooked products were cooled and the cooked weight of the product was recorded.

The yield of the product was calculated as follows:

$$\text{Cooking yield \%} = \frac{\text{Cooked weight of meat}}{\text{Raw weight of meat}} \times 100$$

(Murphy *et al*., 1975) [17]

pH

pH was done for all the samples by following the methods described by AOAC (1995) [3] method at every 3 days interval up to 15 days in case of refrigeration storage and 0, 7, 14, 21, 30 days of frozen storage.

Microbiological evaluation

Total plate count (TPC)

Enumeration of the organisms was done in the standard 'plate count agar medium' by following the 'spread plate method', which was described by APHA (2015) [4] for all the samples at every 3 days interval up to 15 days in case of refrigeration storage and 0, 7, 14, 21, 30 days of frozen storage.

Counts for Escherichia coli

Counts for *E. coli* were done by the inoculating of all the samples after decimal dilution on 'Mac Conkeys Agar plate' followed by the 'spread plate method', which was described by the ISO 16654:2001 for all the samples at every 3 day interval up to 15 days in case of refrigeration storage and 0, 7, 14, 21, 30 days in case of frozen storage sample.

Staphylococcus aureus

For determining the presence or absence of *Staphylococcus aureus*, at first serial dilution was done up to 10^{-2} for all the product sample, followed by the inoculating into the 'Baird Parker agar plate', which was described by the FDA bacteriological analytical manual, ISO 6888-1:2003 method was followed for all the samples at every 8 days interval up to 16 days for refrigeration storage and 0 and 30 days in case of frozen storage sample.

Grams reaction

A thin smear was made from the Individual black colour colonies, which was stained with by the gram stain and see under the microscope and if the organism showed appearance in groups of spherical cocci or grape-like clusters, then it indicated a positive reaction by the gram staining.

Catalase test

A catalase test was done in gram-positive colonies to detect their ability to production of catalase. For this test, a loopful broth of cultured organisms were placed on the clean, sterile, glass slides and gently addea d few drops (2-3 drops) of 3% H_2O_2, then gently mixed with the help of glass rods. If there is a formation of air bubbles because of release the nascent oxygen then it is considered as positive in catalase test (Harrigan and McCance, 1976) [8].

Coagulase test

'Tube Method' were most commonly followed for determining the coagulase positive organisms. For this test 0.5 ml diluted plasma of human were placed in two test tubes, and then add 0.5 ml of the test organisms which was cultured in 18-24 hours in nutrient broth. After that those tubes are incubated in 37 °C temperature and examined every one hour interval at least 24 hours. If there is a clotting of plasma occur then it indicate that the organism was positive in coagulase test.

Salmonella

For determining the presence or absence of *salmonella* organisms in all the samples, the ISO 6579:2002 method will be followed along with slight modification. All the samples were analyzed at every 8 day intervals up to 16 days for refrigeration storage and 0 and 30 days in case of frozen storage. This is done by the, 25 gm portion of sample were mixed with 225 ml of buffered peptone water (As a pre - enrichment medium) in the conical flask and incubated in the 37 °C temperature for 24 hours. After incubation, 10 ml of that culture were transferred in 100 ml broth of tetrathionate and again incubate it 43 °C for 72 hours.

Listeria monocytogenes

For determining the presence or absence of *Listeria monocytogenes* in all the samples at every 8 day interval up to 16 days for refrigeration storage and 0 and 30 days in case of frozen storage, the method described by Ryser and Donnelly (2001) [21] method will be followed.

Psychrophilic bacterial count

Enumeration of the organisms under psychrophile Ic

condition was done by the method which was described by Ercolini *et al*., (2009) at every 3 day interval up to 15 days in case of refrigeration storage (R1 and R2) and 0, 7, 14, 21, 30 day of frozen storage (F1 and F2) sample.

Sensory evaluation

Standard method for sensory evaluation was done by the using of an 8 point Hedonic scale (Keeton, 1983) method followed with slight modification, where 8-excellent and 1-extremely poor, samples was preheated in the microwave to an internal temperature of 80 ^{0}C, prior to serve to the panelists and water were provided to rinse the mouth in between testing of the samples. The panelists were judged the products for appearance, texture, flavour and juiciness of the product by using the score card at every 3 days interval (up to 15 days) in case of refrigeration storage and 0, 7, 14, 21, 30 day for frozen storage of the product.

Cost of production

The production cost of the modified Wahan Mosdeng (Pork Vorta) was calculated on the market value of different ingredient which was used during the production of Wahan Mosdeng. Cost of labour and consumed fuel was also estimated during the analysis of cost of production.

Statistical Analysis

The data obtained through these experiments were statistically analyzed by the method of (Snedecor and Cochran, 1995) using SPSS version 20.

The significant values in the ANOVA were further tested through Duncan multiple range test. Results are depicted as Mean±S.E and when $p<0.05$, $p<0.01$ and p= 0.00 then the differences were considered significant.

Results and Discussion

As above detailed mentioned in the materials and methods, the experiment was done in four different treatment group and the data were collected under different storage days in refrigeration and frozen storage. The reproducibility and reliability of results in monitoring the changes of Wahan Mosdeng (Pork vorta) treated with different types of curing ingredient along with Nisin and in refrigeration and frozen storage condition were studied. The obtained results from these experiments are presented below.

Physico-chemical properties of the Wahan Mosdeng

Cooking Yield

Cooking yield of MWM was (82.14 ± 0.88) higher than the TWM (74.77 ± 0.85) was also observed during the preparation of sample and the yield of MWM was statistically highly significant ($p<0.01$) then the yield of TWM. Cooking yield of TWM and MWM was expressed in percentage **(**Table 2**,** Figure 1**)**

In this experiments, cooking yield of MWM were significantly ($p<0.01$) higher than the TWM. This might be due to the difference in formulation procedure and ability to water retention by the product. Chandralekha *et al*., (2012) [6] also reported the similar finding in meat balls. Ginger also has the ability to increase the cooking yield of the product reported by Naveena and Mendiratta (2001) [18] in spent hen meat and Abdeldaiem *et al*., (2013) [1] in camel meat.

Table 2: Cooking yield of traditional and modified Wahan Mosdeng on 0 d (Mean ± S.E)

Treatment	Cooking Yield (%)
TWM	74.77 ± 0.85
MWM	82.14 ± 0.88
t Value	5.98**

n=6, **Significant at 1% ($p<0.01$), *Significant at 5% ($p<0.05$), NS-Non-significant.

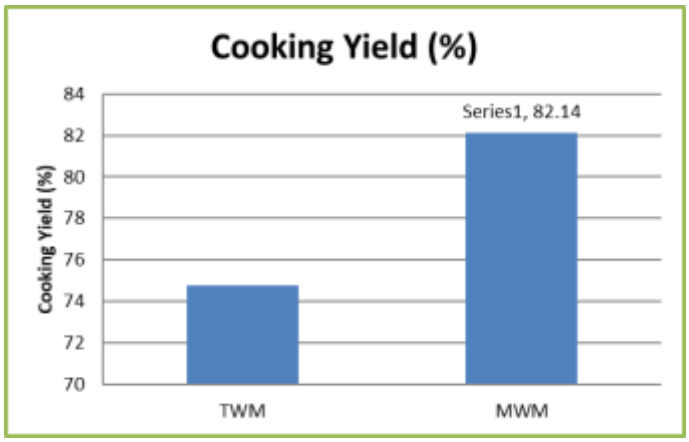

Fig 1: Cooking yield of traditional and modified Wahan Mosdeng on 0 d (Mean ± S.E)

pH

pH of traditional and modified Wahan Mosdeng stored under the refrigeration temperature was assessed on 1st, 3rd, 6th, 9th, 12th and 15th days of storage period. On refrigeration storage obtained pH value are showing on Table 3 and Figure 2.

For R1 sample pH value increased significantly ($p<0.01$) from 6.06 ± 0.022 (D1) to 6.38 ± 0.005 (D9) storage then decreased significantly ($p<0.01$) from 6.38 ±0.005 (D9) to 6.29 ± 0.004 (D15) storage periods under refrigeration temperature. Similar thing also Noticed incase of R2 sample, that pH value increased significantly ($p<0.01$) from5.81 ±0.010 (D1) to 6.28 ±0.009 (D9) storage then decreased significantly ($p<0.01$) from 6.28 ±0.009 (D9) to 6.18 ±0.006 (D15) under refrigeration temperature.

Table 3: pH of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

PH	Period of Storage (D)						F Value
	D-1	D-3	D-6	D-9	D-12	D-15	
R1	6.06 ± 0.022 ^{a}	6.12 ± 0.014^b	6.22 ± 0.014^c	6.38 ± 0.005^d	6.35 ± 0.004 ^{e}	6.29 ± 0.004^f	100.15**
R2	5.81 ± 0.010 ^{a}	5.96 ± 0.012^b	6.09 ± 0.013^c	6.28 ± 0.009^d	6.24 ± 0.006 ^{e}	6.18 ± 0.006^f	327.07**
t Value	10.274**	8.347**	6.80**	9.668**	12.688**	13.201**	

n=27, **Significant at 1% ($p<0.01$), *Significant at 5% ($p<0.05$), NS-Non-significant

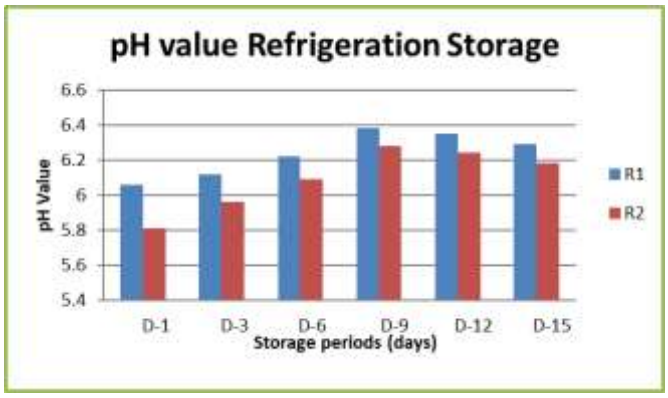

Fig 2: pH of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

In frozen storage pH value of the samples (F1 and F2) was evaluated on 0, 3rd, 7th, 14th, 21st and 30th days of storage periods respectively and the obtained results are showing on Table 4 and Figure 3.

Under frozen storage pH value of F1 sample was also increased significantly (p<0.01) from 6.06 ± 0.022 (D0) to 6.27 ±0.002 (D14) then decreased significantly (p<0.01) from 6.27 ±0.002 (D14) to 6.09 ± 0.006 (D30). These similar trends was also noticed in F2 sample, pH value increased significantly (p<0.01) from 5.81 ± 0.010 (D0) to 6.21 ± 0.003 (D14) then decreased significantly (p<0.01) from 6.21 ± 0.003 (D14) to 6.04 ±0.004 (D30) during frozen storage.

Stiles (1991) [23]; Blixt and Borch (2002) [5]; Karabagias *et al.* (2011) [12]; Patsias *et al.*, (2006) [19]; Jeremiah (2001) [11]; Gok *et al.*, (2008) [7]; also reported that in vacuum packaged and MAP meat products, decrease in pH value due to the lactic acids production in meat and low oxygen environment favored the metabolisms and growth of LAB.

Table 4: pH of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

PH	Period of Storage (D)					F Value
	D-0	D-7	D-14	D-21	D-30	
F1	6.06 ± 0.022 [a]	6.21 ± 0.014[b]	6.27 ± 0.002[c]	6.21 ± 0.003[d]	6.09 ± 0.006 [e]	50.02**
F2	5.81 ± 0.010 [a]	6.13 ± 0.017[b]	6.21 ± 0.003[c]	6.18 ± 0.004[d]	6.04 ± 0.004[e]	287.68**
t Value	10.274**	3.489**	11.381**	6.387**	7.237**	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant.

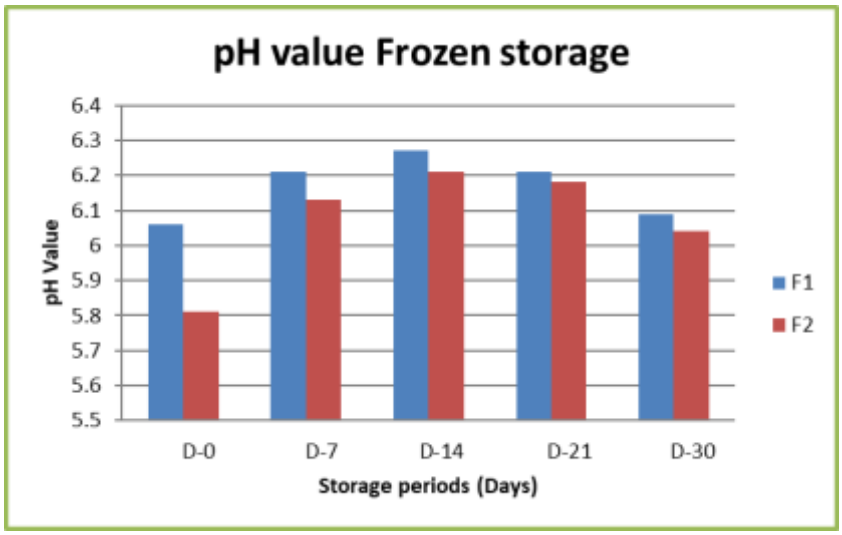

Fig 3: pH of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Microbiological analysis of the Product

Total plate count (TPC)

In R1 sample TAPC was highly significant (p<0.01) increases from 0 day 1.29± 0.005 log10cfu/g to 1.97± 0.011 log10cfu/g on 15th days of storage and for R2 sample TAPC was also highly significant (p<0.01) increases from 0 day 1.18 ± 0.005 log10cfu/g to 1.83 ± 0.011 log10cfu/g on 15th days of storage (Table 5, Figure 4).

In between R1 and R2 sample there was also a highly significant (p<0.01) difference throughout the storage periods.

Table 5: Total plate count (log10cfu/g) of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

TAPC	Periods of storage(D)						F value
	D-0	D-3	D-6	D-9	D-12	D15	
R1	1.29± 0.005[a]	1.43± 0.011[b]	1.56± 0.005[c]	1.75± 0.005[d]	1.80± 0.011[e]	1.97± 0.011[f]	766.4**
R2	1.18± 0.005[a]	1.34± 0.005[b]	1.40± 0.011[c]	1.62± 0.005[d]	1.75± 0.011[e]	1.83± 0.005[f]	964.2**
T value	13.47**	6.97**	12.39**	15.92**	3.06*	10.84**	

n=9, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

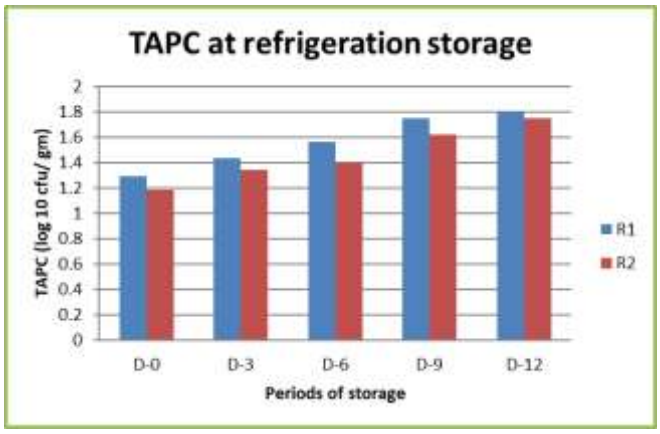

Fig 4: Total plate count (log10cfu/g) of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Non-significant difference was observed in both the samples (F1 and F2) under frozen storage with the advancement of storage periods but in between the sample there was a significant difference was observed throughout the storage periods (Table 6, Figure 5).

Anandh and Lakshmanan, (2010) [2] also noticed that in smoked buffalo tripe roll TPC increased significantly with the advancement of storage periods.

Table 6: Total plate count (log10cfu/g) of traditional and modified Wahan Mosdeng kept under frozen storage -18 to - 22°C (Mean ± S.E)

TAPC	Periods of storage(D)					F value
	D-0	D-7	D-14	D-21	D-30	
F1	1.29± 0.00^{a}	1.30± 0.00^{b}	1.30± 0.01^{c}	1.29± 0.00^{d}	1.30± 0.00^{e}	0.40^{NS}
F2	1.18± 0.00^{a}	1.18± 0.00^{b}	1.19± 0.00^{c}	1.18± 0.00^{d}	1.19± 0.01^{e}	0.56^{NS}
tvalue	13.47**	14.69**	8.52**	13.47**	6.74**	

n=9, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

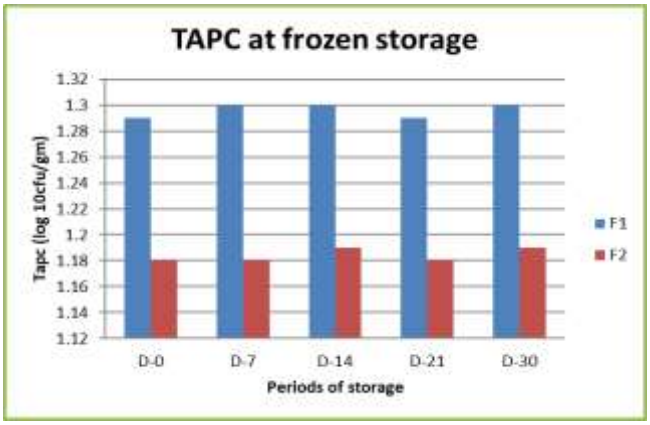

Fig 5: Total plate count (log10cfu/g) of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Counts for Escherichia coli

E. coli organism was evaluated on every 3 days intervals up to 15 days in refrigeration storage sample but E. coli organism was not detected in both refrigeration storage sample (R1 and R2).

In frozen storage E. coli organism was evaluated on 0, 7, 14, 21, 30 days of storage but E. coli organism was not detected in both frozen storage sample (F1 and F2).

Presence or absence of *Salmonella*

Salmonella organism was evaluated on every 8 days intervals up to 16 days in refrigeration storage sample but Salmonella organism was not detected in both refrigeration storage sample (R1 and R2) presented in Table 7.

Salmonella organism was evaluated on 0 and 30 days of storage in frozen storage, but Salmonella organism was not detected in both frozen storage sample (F1 and F2) presented in Table 8.

Presence or absence of *Staphylococcus aureus*

For the presence or absence of *Staphylococcus aureus*, under refrigeration storage sample (R1 and R2) were evaluated on every 8 days at intervals up to 16 days, presented in Table no 7 and the *Staphylococcus aureus*, the organism was isolated from refrigeration storage TWM (R1) sample throughout the storage periods.

But frozen storage samples (F1 and F2) were evaluated on 0 and 30 days for the presence or absence of *Staphylococcus aureus*, presented on Table no 8 and the *Staphylococcus aureus*, the organism was found to be positive in frozen storage TWM (F1) sample throughout the storage periods.

Presence or absence of *Listeria monocytogenes*

Presence or absence test for *Listeria monocytogenes*, *was* also evaluated on every 8 days intervals up to 16 days of refrigeration storage sample (R1 and R2), presented on Table no 7 and 0 and 30 days of frozen storage sample (F1 and F2), presented on Table no 8. This study indicate the absence of *Listeria monocytogenes* in all the treatment groups.

Table 7: Presence and absence test of *Salmonella*, *Staphylococcus aureus and Listeria monocytogenes* organism of Traditional and Modified Wahan Mosdeng kept under refrigeration storage at 4±1°C.

Treatment	Periods of storage(D)					
	Salmonella		*Staphylococcus aureus*		*Listeria monocytogenes*	
	D-0	D-16	D-0	D-16	D-0	D-16
R1	-	-	+	+	-	-
R2	-	-	-	-	-	-

n=6.

Table 8: Presence and absence test of *Salmonella, Staphylococcus aureus and Listeria monocytogenes* organism of Traditional and Modified Wahan Mosdeng kept under frozen storage -18 to -22°C.

Treatment	Periods of storage(D)					
	Salmonella		*Staphylococcus aureus*		*Listeria monocytogenes*	
	D-0	D-30	D-0	D-30	D-0	D-30
F1	-	-	+	+	-	-
F2	-	-	-	-	-	-

n=6

Psychrophilic bacterial count

The psychrophilic bacterial count was done in every 3 days interval up to 15 days for the refrigeration storage sample (R1 and R2) and the results are presented on Table.9 and Fig. 6.

The psychrophilic bacterial count was significantly increased (p<0.01) throughout R1 and R2 sample storage periods ple under refrigeration temperature.

Statistically significant (p<0.01) difference was also observed in between the R1 and R2 samples, throughout the storage periods.

Table 9: Psychrophilic count (log10cfu/g) of TWM and MWM kept under refrigeration storage at 4±1 °C (Mean ± S.E).

Psychrophilic	Periods of storage(D)						F value
	D-0	D-3	D-6	D-9	D-12	D15	
R1	1.27± 0.01^{a}	1.31± 0.01^{b}	1.36± 0.00^{c}	1.45± 0.00^{d}	1.54± 0.02^{e}	1.57± 0.01^{f}	135.15**
R2	1.16± 0.01^{a}	1.24± 0.00^{b}	1.29± 0.01^{c}	1.38± 0.01^{d}	1.41± 0.02^{e}	1.43± 0.00^{f}	69.86**
T value	11.66**	6.95**	6.01**	4.26*	4.17*	10.84**	

n=9, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

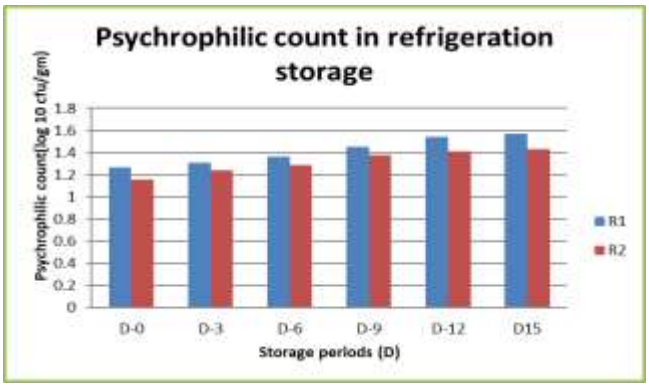

Fig 6: Psychrophilic count (log10cfu/g) of TWM and MWM kept under refrigeration storage at 4±1 °C (Mean ± S.E).

The psychrophilicc bacterial count was done on 0, 7th, 14th, 21st, and 30th days of frozen storage periods and a non-significant (p>0.05) difference was observed in both frozen storage samples (F1 and F2) with the advancement of storage periods, presented on Table.10 and Fig. 7.

In between the samples highly significant (p<0.01) difference was observed throughout the storage periods.

Table 10: Psychrophilic count (log10cfu/g) of TWM and MWM kept under frozen storage at -18 to -22 °C (Mean ± S.E).

Psychrophilic	Periods of storage(D)					F value
	D-0	D-7	D-14	D-21	D-30	
F1	1.17± 0.00^{a}	1.18± 0.00^{b}	1.16± 0.01^{c}	1.16± 0.01^{d}	1.17± 0.01^{e}	0.95^{NS}
F2	1.11± 0.00^{a}	1.12± 0.00^{b}	1.11± 0.00^{c}	1.12± 0.00^{d}	1.11± 0.00^{e}	1.12^{NS}
tvalue	7.34**	10.39**	6.12**	3.09*	4.65**	

n=9, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

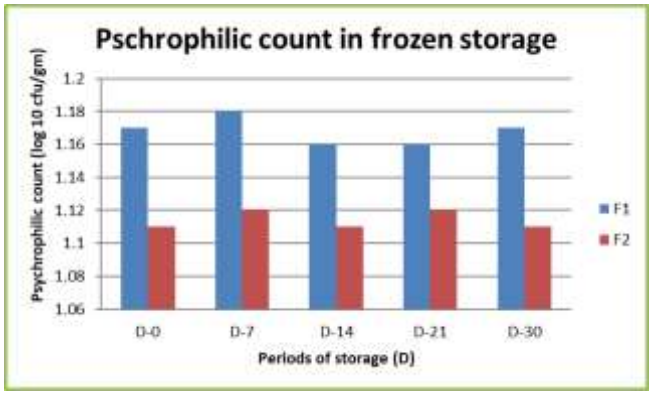

Fig 7: Psychrophilic count (log10cfu/g) of TWM and MWM kept under frozen storage at -18 to -22°C (Mean ± S.E).

Sensory evaluation of the Wahan Mosdeng

The panelist did sensory evaluation for all the samples and they evaluated the Appearance, Flavour, Texture and Juiciness of the products by using the of 8 points Hedonic scale scorecard.

Appearance

In the R1 sample with the advancement of storage periods appearance score was significantly (p<0.01) decreased from 7.03 ± 0.099 (D1) to 5.96 ±0.13 (D15) and for the R2 sample from 7.37 ± 0.121(D1) to 6.07 ±0.12 (D15) was observed, presented on Table 15, Figure 14**.**

It was also noticed that there was a highly significant (p<0.01) difference in between the R1 and R2 samples in 1st

day but on the 3rd, 6th ,9th, 12th ,15th, days of storage periods Non- significant (p>0.05) different was observed in between the R1 and R2 sample.

Table 11: Appearance score of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Appearance	Period OF STORAGE (D)						F Value
	D-1	D-3	D-6	D-9	D-12	D-15	
R1	7.03 ± 0.099 ^{a}	6.85 ± 0.115^{ab}	6.81 ± 0.107^{ab}	6.51 ± 0.09^{b}	6.14 ± 0.127 ^{c}	5.96 ± 0.13^{c}	13.72**
R2	7.37 ± 0.121 ^{a}	7.14 ± 0.102^{ab}	6.92 ± 0.105^{bc}	6.74 ± 0.13^{c}	6.40± 0.096^{d}	6.07 ± 0.12^{e}	16.87**
t Value	2.12**	1.91^{NS}	0.74^{NS}	1.31^{NS}	1.62^{NS}	0.59^{NS}	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

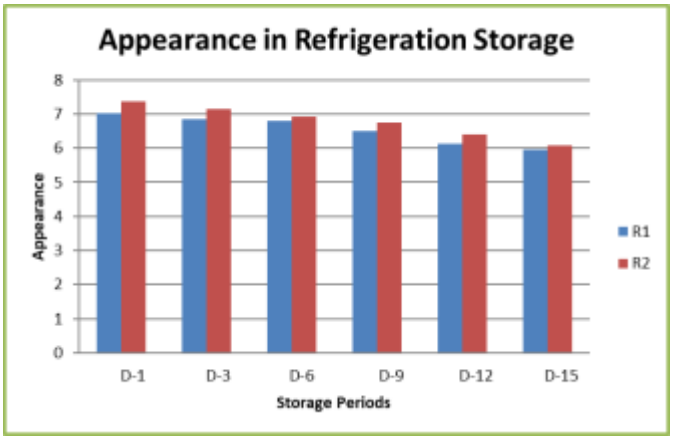

Fig 8: Appearance score of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Under frozen storage appearance of the F1 asamplessample wasjudgede by the panelist on 0, 7, 14, 21 and 30 days of storage periods. With the increase in storage periods appearance score of the product decreases in both F1 and F2 sample (Table 12, Figure 9).

The appearance was decreases significantly (p<0.01) in both F1 and F2 sample from 7.11± 0.13 (D0) to 5.96 ± 0.15 (D30) and from 7.62 ± 0.09 (D0) to 6.33± 0.22 (D30) respectively with the advancement of storage periods.

It was also noticed that there was a highly significant (p<0.01) difference in between the F1 and F2 samples on 0 day but on 7,14,21,30 days of storage periods Non- important (p>0.05) difference was observed in between the F1 and F2 samples.

Table 12: Appearance score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Appearance	Period of Storage (D)					F Value
	D-0	D-7	D-14	D-21	D-30	
F1	7.11± 0.13 ^{a}	6.85 ± 0.13^{ab}	6.51 ± 0.18^{bc}	6.33 ± 0.13^{cd}	5.96 ± 0.15^{d}	9.00 **
F2	7.62 ± 0.09 ^{a}	7.11 ± 0.11^{b}	6.88 ± 0.14^{bc}	6.55 ± 0.13^{cd}	6.33± 0.22^{d}	11.39**
t Value	3.51**	1.46^{NS}	1.60^{NS}	1.18^{NS}	1.34^{NS}	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

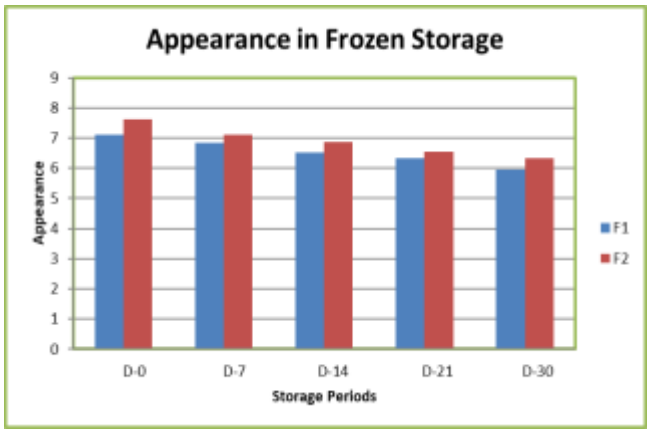

Fig 9: Appearance score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Flavour

The results of panelists for the Flavour of R1 and R2 sample were listed below in Table 17and Figure 16**.** In refrigeration storage,, Flavour score gradually decreased with the increase of storage periods.

In the R1 sample with the advancement of storage periods flavour score was significantly (p<0.01) decreases from 7.03 ± 0.13 (D1) to 5.80 ± 0.15 (D15) and for R2 sample from 7.25 ± 0.08 (D1) to 6.00 ± 0.14 (D15) was observed.

Non- significant (p>0.05) difference was observed in between R1 and R2 sample during 1 and 3rd days of storage periods but on 6, 9, 12 and 15 days of storage periods significant (p<0.05) difference was observed.

Table 13: Flavour score of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Flavour	Period of Storage (D)						F Value
	D-1	D-3	D-6	D-9	D-12	D-15	
R1	7.03 ± 0.13 [a]	7.00 ± 0.11[a]	6.74 ± 0.10[ab]	6.40 ± 0.11[b]	6.18 ± 0.13 [c]	5.80 ± 0.15[c]	12.89**
R2	7.25 ± 0.08 [a]	7.07 ± 0.14[a]	6.96 ± 0.03[ab]	6.74 ± 0.08[b]	6.37± 0.09[c]	6.00 ± 0.14[d]	20.65**
t Value	1.38[NS]	0.40[NS]	2.06*	2.38*	2.14*	2.35*	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

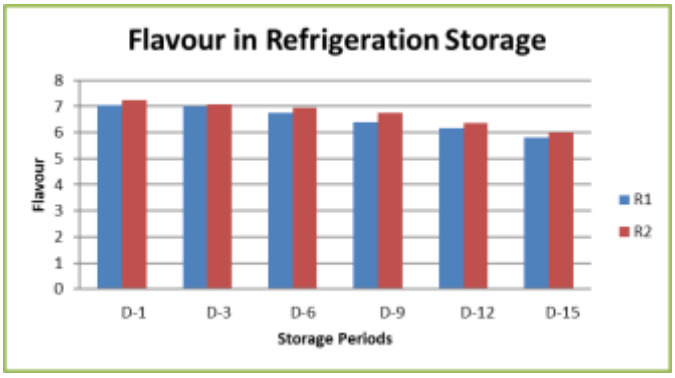

Fig 10: Flavour score of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Under frozen storage flavour of F1 and F2 sample was judge by the panelist on 0, 7, 14, 21 and 30 days of storage periods. With the increasing of storage periods Flavour score of the product decreases in both F1 and F2 sample (Table 14 and Figure 11).

Flavour was decreases significantly (p<0.01) in both F1 and F2 sample from 7.11± 0.14 (D0) to 5.96 ± 0.14 (D30) and from 7.51 ± 0.09 (D0) to 6.22 ± 0.17 (D30) respectively with the advancement of storage periods.

It was also noticed that there was highly significant (p<0.01) difference in between F1 and F2 sample in 0 day but on 7,14,21,30 days of storage periods Non- significant (p>0.05) different was observed in between the F1 and F2 sample

Table 14: Flavour score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Flavour	Period of Storage (D)					F Value
	D-0	D-7	D-14	D-21	D-30	
F1	7.11± 0.14 [a]	6.92 ± 0.15[a]	6.88 ± 0.14[a]	6.44 ± 0.17[b]	5.96 ± 0.14[c]	9.09 **
F2	7.51 ± 0.09 [a]	7.22 ± 0.15[ab]	6.88 ± 0.14[bc]	6.66 ± 0.13[cd]	6.22± 0.17[d]	12.06**
t Value	2.33**	1.37[NS]	0.00[NS]	1.00[NS]	1.12[NS]	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

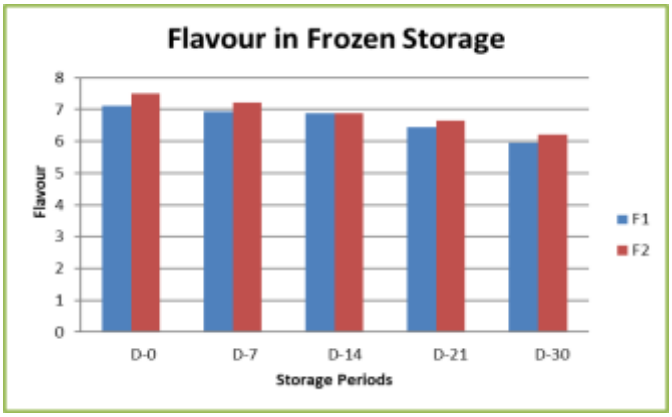

Fig 11: Flavour score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Texture

The results of panelists for the Texture of R1 and R2 sample were listed below Table 19 and Figure 18**.** In refrigeration storage Texture score was gradually decreases with the increasing of storage periods.

In R1 sample with the advancement of storage periods flavour score was significantly (p<0.01) decreases from 7.00 ± 0.13 (D1) to 5.74 ± 0.15 (D15) and for R2 sample from 7.29 ± 0.08 (D1) to 5.85 ± 0.12 (D15) was observed. In between R1and R2 sample Non-significant (p>0.05) difference was observed during all the storage days.

Table 15: Flavour score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Texture	Period Of Storage (D)						F Value
	D-1	D-3	D-6	D-9	D-12	D-15	
R1	7.00 ± 0.13 [a]	6.81 ± 0.16[ab]	6.59± 0.11[bc]	6.33 ± 0.11[cd]	6.03 ± 0.14 [de]	5.74 ± 0.15[e]	11.86**
R2	7.29 ± 0.08 [a]	6.96 ± 0.13[b]	6.74 ± 0.08[bc]	6.48 ± 0.09[c]	6.07± 0.12[d]	5.85 ± 0.12[e]	23.19**
t Value	1.87[NS]	0.70[NS]	1.06[NS]	0.95[NS]	0.19[NS]	0.55[NS]	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

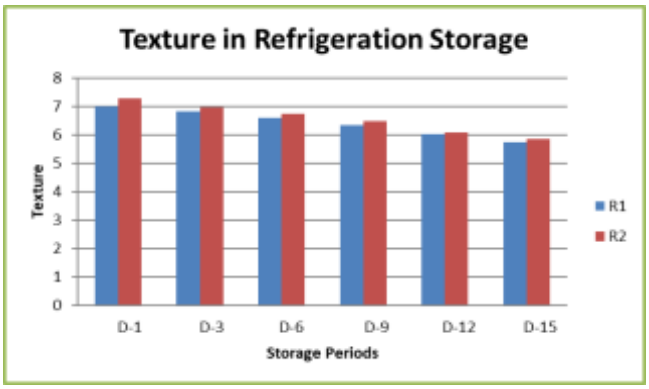

Fig 12: Texture score of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Under frozen storage texture of F1 and F2 sample was judge by the panelist on 0, 7, 14, 21 and 30 days of storage periods. With the increasing of storage periods Texture score of the product decreases in both F1 and F2 sample (Table 16 and Figure 13).

Texture was decreases significantly (p<0.01) in both F1 and F2 sample from 7.03± 0.12 (D0) to 5.85 ± 0.17 (D30) and from 7.22 ± 0.12 (D0) to 6.55 ± 0.13 (D30) respectively with the advancement of storage periods.

In texture score highly significant (p<0.01) different was observed in between F1 and F2 sample during 0 and 30 days of storage but on 7,14, 21 days of storage non- significant (p>0.05) difference was observed.

Table 16: Texture score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Texture	Period of Storage (D)					F Value
	D-0	D-7	D-14	D-21	D-30	
F1	7.03± 0.12 ^{a}	6.96 ± 0.11^{a}	6.70 ± 0.13^{ab}	6.33 ± 0.13^{b}	5.85 ± 0.17^{c}	12.60**
F2	7.22 ± 0.12 ^{a}	7.00 ± 0.16^{ab}	6.88 ± 0.19^{ab}	6.66 ± 0.13^{b}	6.55± 0.13^{b}	3.08*
t Value	1.05**	0.18^{NS}	0.77^{NS}	1.80^{NS}	3.19**	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

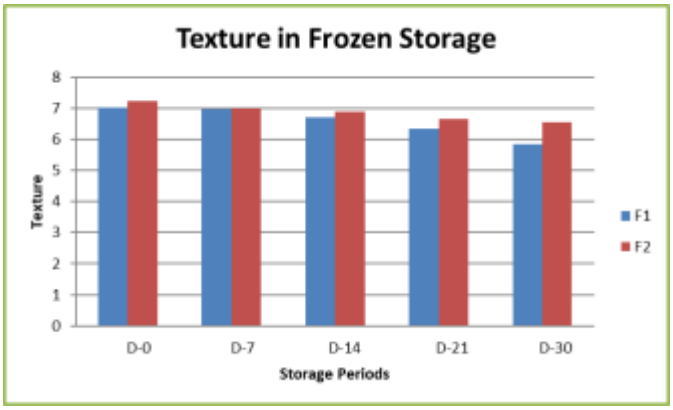

Fig 13: Texture score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Juiciness

The results of panelists for the juiciness of R1 and R2 sample were listed below Table 21 and Figure 20**.** In refrigeration storage juiciness score was gradually decreases with the increasing of storage periods.

In R1 sample with the advancement of storage periods juiciness score was significantly (p<0.01) decreases from 7.07 ± 0.14 (D1) to 5.25 ± 0.11 (D15) and for R2 sample from 7.40 ± 0.09 (D1) to 5.74 ± 0.11 (D15) was observed. But In between R1and R2 sample Non-significant (p>0.05) difference was observed on 1, 3 and 6 days of storage and highly significant (p<0.01) difference was observed on 9, 12 and 15 days of storage periods.

Table 17: Texture score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Juiciness	Period Of Storage (D)						F Value
	D-1	D-3	D-6	D-9	D-12	D-15	
R1	7.07 ± 0.14 ^{a}	6.62 ± 0.16^{b}	6.37± 0.13^{bc}	6.03 ± 0.12^{c}	5.62 ± 0.09 ^{d}	5.25 ± 0.11^{e}	30.54**
R2	7.40 ± 0.09 ^{a}	6.92 ± 0.12^{b}	6.70 ± 0.11^{bc}	6.51 ± 0.09^{c}	6.03± 0.13^{d}	5.74 ± 0.11^{e}	26.93**
t Value	1.95^{NS}	1.74^{NS}	1.88^{NS}	3.03**	2.46**	2.97**	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

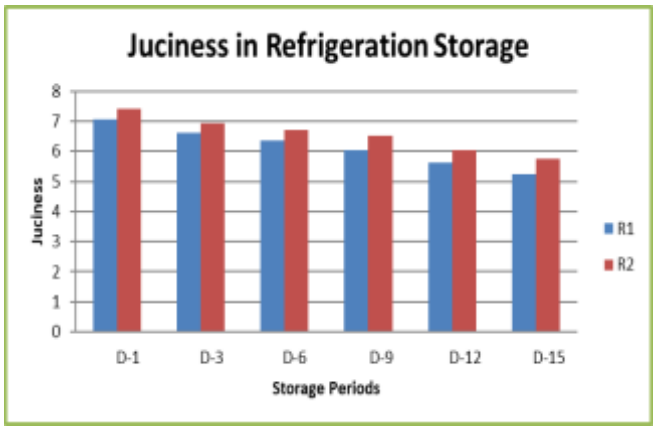

Fig 14: juiciness score of traditional and modified Wahan Mosdeng kept under refrigeration storage at 4±1 °C (Mean ± S.E)

Under frozen storage juiciness of F1 and F2 sample was judge by the panelist on 0, 7, 14, 21 and 30 days of storage periods. With the increasing of storage periods juiciness score of the product decreases in both F1 and F2 sample (Table 18 and Figure 15).

Juiciness was decreases significantly (p<0.01) in both F1 and F2 sample from 7.07± 0.12 (D0) to 5.88 ± 0.17 (D30) and from 7.55 ± 0.09 (D0) to 6.88 ± 0.14 (D30) respectively with the advancement of storage periods.

In juiciness score highly significant (p<0.01) different was observed in between F1 and F2 sample during 0 and 30 days of storage, on 7th days of storage non- significant (p>0.05) difference was observed and during 14 and 21 day of storage significant (p<0.05) difference was observed.

Table 18: Juiciness score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

Juciness	Period Of Storage (D)					F Value
	D-0	D-7	D-14	D-21	D-30	
F1	7.07± 0.12 ^{a}	7.03 ± 0.12^{a}	6.66 ± 0.14^{ab}	6.37 ± 0.17^{b}	5.88 ± 0.17^{c}	10.49**
F2	7.55 ± 0.09 ^{a}	7.22 ± 0.15^{ab}	7.11 ± 0.14^{b}	7.00 ± 0.16^{b}	6.88± 0.14^{b}	3.25*
t Value	2.96**	0.93^{NS}	2.19*	2.62*	4.33**	

n=27, **Significant at 1% (p<0.01), *Significant at 5% (p<0.05), NS-Non-significant

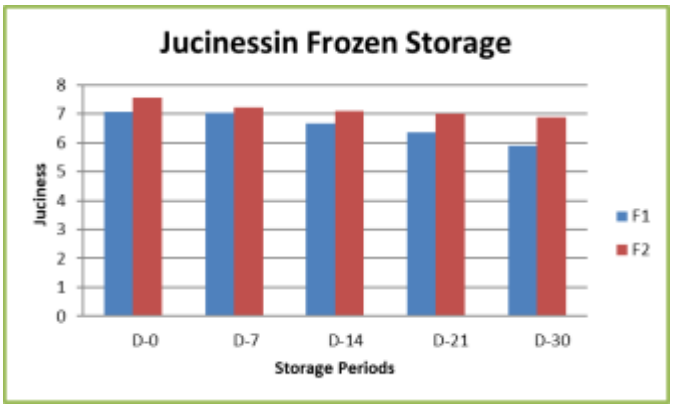

Fig 15: Juiciness score of traditional and modified Wahan Mosdeng kept under frozen storage at -18 to -22 °C (Mean ± S.E)

All the sensory parameter was decreased with the advancement of storage periods might be due to the decrease in moisture content, Microbial activity, pH, oxidation fat etc. Kumar *et al*., 2007 [16] reported that in pork nuggets different sensory characteristic like tenderness, juciness, flavor are significantly decreases by the storage periods of the products. Increased TBA value in the food products due to the oxidation of fat and this is one of the reasons for getting low score in the aspect of flavor and colour in pork petties (Kumar *et al.*, 2007) [16].

Cost of production of MWM versus TWM

The production cost of modified Wahan Mosdeng, which was somewhat higher than the Traditional Wahan Mosdeng. On the basis of above physico-chemical, Sensory, Microbiological parameter MWM was superior and it would command higher market demand then the TWM. Nowadays consumers are more quality conscious and ready to pay more for the better quality products. Up gradation of production technology for the traditional products is also necessary for the export of traditional products in different states of India and other neighbor country.

The production cost for the formulation of 1 kg Traditional Wahan Mosdeng and Modified Wahan Mosdeng (pork vorta) was estimated. Production cost was estimated to about Rs. 416/ kg for TWM and Rs. 426/kg for MWM.

Conclusions

Taking into account the overall outcome and results obtained in the study, the below listed conclusions could be drawn upon:

1. By the application of turmeric powder and other chemical preservatives a modified form of ready-to-eat Wahan Mosdeng could be developed successfully.
2. MWM recorded superior quality in Physico- chemical, proximate composition, microbiological and sensory parameter and also highly acceptable even after 15 days of refrigeration storage and 30 days of frozen storage sample.
3. This study also leads to conclude that MWM can be prepared by little up gradation of the technology with negligible increase in production cost.

Acknowledgment

This present study was performed by the grant from central Agricultural University as a Master's research. We appreciate their financial help and also to give the permission for the research.

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