

The Performance Evaluation on the Effectiveness of Nspri's Ice-Fish Box

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Abstract: *The Performance Of Nspri's Iced-Fish Box, A Technology For Short Term Cool Storage Of Fish, Developed And Constructed By Nigerian Stored Products Research Institute (Nspri) Were Evaluated. Ice, And Catfish (Clariasgariiepnus) Were Purchased. The Purchased Quantities Of Ice And Catfish Were Shared Into Two Parts And Simultaneously Introduced Into The Boxes At The Same Ratio For Load Test Experiment And Only Ice Were Utilized For The No Load Test Experiment. Two Of The Boxes Were Used For Both Test Experiment With One Kept Inside The Laboratory And The Other Running Concurrently Outside At Ambient Condition. The Performance Level Of The Boxes Containing Ice And Fish At Proposed Ratio Were Noted For Both Test Conditions. Thermohygrometers Were Used To Measure The Temperature And The Relative Humidity Within And Outside Of The Boxes At Load And No Load Test Experiment Condition That Was Carried Out. At The End Of The Experiment, It Was Found That The Ice Used Last Longer At Load Test Than At No Loaded Condition, With Initial High Melting Rate Noticed With Load Experiments Before A Stable Melting Rate Is Reached And Maintained. The Quality Of The Fishes Was Kept Visibly Fresh Without Offensive Smell Of Decadence. The Fish Box Was Found To Be A Simple, But Cost Effective Technology That Preserved That Fresh Caught Quality Of Fish And Allow For Safe Temporary Transport And Storage. The Research Work Established The Working Parameter And The Duration Effectiveness Of The Box To Maintain Fish Freshness, And Possibly Served As A Discovery Venture For Necessary Modification Needs Of This Developed Technology For Short Time Cool Storage Of Fresh Fish.*

Keywords: *Fishbox, Fish, Ice, Temperature, Thermohygrometer, Relative Humidity.*

I. Introduction

Fish Is A Highly Perishable But Valued Food Source That Requires Proper Handling And Preservation After Harvest To Increase Its Shelf Life, Retain Its Fresh Quality, Flavour, And Nutritional Attributes. Fish Freshness Is Commonly Maintained By Cooking Them Immediately They Comes Out Of Water, But In Case Of When A Reasonably Large Amount Of Fish Is Harvested, The Best Obvious Way To Keep Them Safe, Avoid Spoilage And Prevent Loss Of Freshness On Short Time Storage Is The Use Of The Methods Of Cool Storage One Of Which Involves The Introduction Of Fish Into An Iced-Insulated Lagged Material Immediately After Harvest To Enhance Freshness Until It Is Needed For Consumption [1]. Also, According To Bremner Ha (2003) On Fish Processing, The Best Way Of Maintaining The Freshness Of Harvested Fish Is By The Immediate Application Of Crushed Ice On Them Once Killed [2][3][4][5].

Nspri's Iced Fish Box, A Technology Developed By Nigerian Stored Products Research Institute Is A Portable, Semi-Air-Tight Lagged-Coolant System Of The Dimension 49cm × 29cm × 20cm With An Effective Cooling Capacity Due To Uniform Coldness Distribution Within The Box. This Is Now Used For Short Term Fish Preservation Which Involves The Introduction Of A Measured Proportion Of Ice Into A Given Quantity Of Fish Within An Insulated Lagged Rectangular Vacuum To Maintain Fish Freshness Within The Boxes. As Shown In The Figure Below:



Fig.1: Pictorial Representation Of The Nspri's Iced-Fish Box. Source: Ishola D.T, 2012

II. Materials And Methods

The Fish And Ice Used For This Study Were Purchased From Yankura Fish Market And The Ice Used From An Ice Making-Factory Along Murtala Mohammed Road Opposite Access Bank In Kano State Of Northern Nigeria Respectively.

Two Nspri's Fish Boxes Were Collected From The Extension Store, Prepared And Transferred To The Chemistry Laboratory In Preparation For The Experiment Proper. The Dimensions Of The Boxes Were Also Taken. Market Survey Which Was Conducted A Months Before Was Repeated A Day Before The Experiment Proper Began, This Was In Lieu Of Reaching Or Ascertaining The Certainty Of The Availability And Current Prices Of All The Material Needed Such As The Ice And Fish. The Experiment Which Was Designated To Take Place In Two Phases (No Load Test And Loaded Test Of Varying But Specific Ratio) Was Done Under Two Conditions; Room And Ambient (I.E. Inside And Outside The Lab). The Experiment Proper Began With The No Load Test.

2.1 No Load Test Experiment: No Load Test Condition Is One Which Involves An Introduction Of Measured Quantity Of Ice Only Into The Fish Box And Consequently Monitoring And Recording At Intervals The Time Range It's Takes To Completely Melts. Ice Were Purchased From An Ice Making-Factory Along Murtala Mohammed Road, Kano State And Transported To The Office Premises. This Was Done For Two Ice Ratios (25%, And 50%) Only. No Load Test Of 25% (Ice Only) Was Carried Out First. Here, 25% Of Crushed Ice (Broken Block Of Ice) Corresponding To 10kg By Mass Were Weighed, And Introduced Into The Two Boxes, Thermo Hygrometer Were Instantly Inserted Inside The Boxes. One Of The Boxes Was Left Inside The Laboratory And The Other Was Immediately Transferred Outside The Lab But Within The Office Premises. The Initial Temperature And Relative Humidity Of Both The Ambient And Those Within The Semi Air-Tight Lagged Boxes Were Immediately Taken. Subsequently, Readings Were Taken At An Interval Of One (1) Hour Until The Whole Ice Melted Out Completely.

The Same Procedure Follow Suite For The No Load Test Of 50% (Ice Only). 50% Of Broken Block Of Ice Corresponding To 20kg By Mass Were Weighed, And Introduced Into The Two Boxes.

2.2 Load Test Experiment: Load Test Experiment In This Context Involves An Introduction Of Measured Quantity Of Ice And Fish Into The Fish Box At A Specific Ratio And Consequently Monitoring And Recording The Time Range The Ice Completely Melts. The Load Test Experiment Began A Day After The Completion Of No Load Test Experiment. Required Amount Of Ice Were Purchased From The Same Ice-Making Factory From Which The First Purchase Was Made For Those Used For No Load Test Experiment.

2.3 Fish Processing: A Total Of 70 Live Africa Catfish (*Clarias gariepinus*) Aged Five Months With Average Body Weight And Length Of 850 ± 20 g And 35 ± 10 Cm Respectively Were Obtained From Major Catfish Dealer Within Yankura Fish Market Of Kano State. The Fishes Were Transported To The Laboratory, Killed, Thoroughly Washed With Water Containing Some Dissolved Common Salt, And Prepared Without The Removal Of Their Heads. The Dressed Carcasses And The Broken Ice Were Appropriately Weighed Using A Weighing Balance And The Supposed Quantity Of Ice To Fish Ratio (1:1; 1: 2) Required For The Loaded Test Were Carefully Measured And Immediately Transferred And Arranged Into The Boxes In Three (3) Layers Namely; Ice-Fish-Ice Format. This Is To Enhance Even Distribution Of The Coolness Within The Box. This Format Was Ensured For The Two Ice To Fish Ratio (25% And 50%; 50% And 50%) Test Procedure.

III. Results And Discussion

From The Result Obtained For No Load Test Experiment That Was Carried Out, 25% Ice (I.E. 10kg Ice) Of The Box Kept Outside The Lab Lasted For Approximately 20hours, While The Corresponding Box Of 25% Ice Kept Inside The Lab Lasted For 21hours. One (1) Hour Time Range Difference Was Observed Between Them As Shown In Table 1 Below.

In Case Of 50% Ice (I.E. 20kg Ice) Of The Box Kept Outside The Lab, The Experiment Lasted For Approximately 28hours (From 10:30am To 1:05pm Of The Next Day), While The Corresponding 50% Ice Used For The No Load Test Kept Inside The Lab Lasted For About 33hours (From 10:30am To 6:30pm Of The Next Day). Five (5) Hour Time Range Difference Was Observed Between Them As Shown In Table 2 Below.

For Load Test Experiment (25 And 50% Ice To Fish Ratio; 50 And 50% Ice To Fish Ratio) Carried Out, It Was Observed That The Fish Box Kept Outside The Lab For 25:50% Ice To Fish Ratio (I.E. 10kg Ice To 20kg Fish Ratio) Lasted For Approximately 24hours, While The Corresponding Box Of 25:50% Ice To Fish Ratio (I.E. 10kg Ice To 20kg Fish) Kept Inside The Lab Lasted For 28hours. Four (4) Hours' Time Range Difference Was Observed Between Them As Shown In Table3below. The Fishes Were Still In Good Condition.

For 50:50% Ice To Fish Ratio (I.E. 20kg Ice To 20kg Fish Ratio) Loaded Test Experiment, The Fish Box Kept Outside The Lab Lasted Approximately 33hours, While The Corresponding Box Of The Same Ice To

Fish Ratio That Was Kept Inside The Lab Lasted For 34hours. The Fishes Were Still In Good Condition. One (1) Hour Time Range Difference Was Observed Between Them As Shown In Table 4.

Furthermore, When Ice And Fish Were Introduced Into The Boxes, It Was Observed That The Temperature Within The Boxes Was Initially High And Ice Melting Rate Was Faster With An Evident Of More Water Droplets Noticed From The Water Draining Outlet At The Base Of The Box. Later The Temperature Within The Boxes Started Decreasing And After A While Stabilized With Corresponding Effect On Ice Melting Rate. This Was Strongly Linked To Rapid And Even Distribution Of The Ice Within The Box And The Consequent Absorption Of Coolness Oozing Out Of The Ice By The Fish. Temperature And Melting Rate Stability Observed Was Also Inferred To Be Responsible For Longer Melting Time Rate Of Approximately 33 And 34hours Observed During The 50:50% Ices To Fish Ratio For The Load Test Experiment As Against That Of 50% Only Ice Of No Load Test Of 27 And 33hours Respectively (Table2 And 4). It Was Observed That After The Ice Melted Completely, The Final Weight Of The Fishes Taken Revealed That They Have Gain Additional Weight Ranging From +2 To 8g Compared To Their Initial Weight Taken Before Ice Was Added, And Their Physical Freshness Was Still Maintained []. Even, When Additional Measured Ice Were Introduced Into A Few Of Them And Kept On Storage, After The Melting Duration Of The Specified Ratio Of Ice (25% And 50%) Have Been Achieved And Recorded, The Fishes Stayed On Being Fresh For Another 5days. As It Was Stated By N'goma 1993 That The Quicker The Ice Chills The Better The Freshness Of The Fish, And That Melting Ice Reduce Weight Loss Of The Fish [8] [9] [10] [11] [13]. After Five Days Extension Of The Load Text Experiment By Adding Only Ice, It Was Later Noted That The Dark Nature Of The Cat Fish Skin Was Gradually Fading Out Compared To When First Sighted, But No Smell Of Decadence Was Observed Yet. It Becomes Evident That The Ice Does Not Only Limit Bacteria Growth (Especially Bacteria Associated With Warm Water Fish Like Catfish That Normally Adapt To Temperature In The 65-90^of Range), It Also Washes Bacteria Off The Fish As It Melts And Renders Them Inactive For That Period Of Time. This Then Propelled An Idea To Compare The Nutritional Contents And The Organoleptic Qualities Of Fresh Not Iced-Dried Catfish With The Iced-Dried Ones, Primarily To Evaluate And Establish A Point Of Variance, If Possible (Project Ongoing). It Was Also Noted That The Mucus Secreted From The Skin Of The Cat Fish Sample Used Start Experiencing Significant Coagulation From Day Two Of The Experiment With An Evident Of Curdling At One Side Of The Box, And The Body Of The Fish Become Less Slippery [12] [13] [14]. This Also Instigated An Idea To See To The Improvement Of The Box Drainage System To Reduce Further Contamination. The Results For No Load Test Experiment For The Two Ice Ratios (25%, And 50%), And Ice To Fish Ratio For Load Test Experiment (50:50; 25:50)Are Shown In The Table 1 To 4 Below;

S/No	Inside Laboratory(Room Condition)					Outside Laboratory(Ambient Condition)			
	Time (Hr)	In(Space Within The Box)		Out(Ambient)		In(Space Within The Box)		Out (Ambient)	
		T _{ai} (^o c)	Rh _i (%)	T _{ao} (^o c)	Rh _{ao} (%)	T _{bi} (^o c)	Rh _{bi} (%)	T _{bo} (^o c)	Rh _{bo} (%)
1	1:30pm	11.50	48	32.60	45	16.40	-----	41.70	37
2	2:30pm	2.90	71	33.10	44	10.20	-----	41.10	22
3	3:30pm	3.00	77	32.80	43	8.70	-----	41.80	20
4	4:30pm	2.60	80	33.20	41	8.80	-----	42.90	20
5	5:30pm	2.30	81	32.50	47	5.80	-----	30.00	40
6	6:30pm	1.80	83	31.80	43	0.70	-----	29.00	51
From 6:30pm-6:30am No Reading Was Taken									
7	7:30am	4.80	84	28.40	64	1.00	-----	29.40	69
8	8:20am	5.90	83	29.00	64				
Melted Completely Exactly At 8:20am									

Table 1: Temperature And The Relative Humidity Results For Twenty Five Percent (25%) Of Ice Used For No Load Test.

S/No	Inside Laboratory(Room Condition)					Outside Laboratory(Ambient Condition)			
	Time (Hr)	In(Space Within The Box)		Out(Ambient)		In(Space Within The Box)		Out (Ambient)	
		T _{ai} (^o c)	Rh _{ai} (%)	T _{ao} (^o c)	Rh _{ao} (%)	T _{bi} (^o c)	Rh _{bi} (%)	T _{bo} (^o c)	Rh _{bo} (%)
1	10:30am	16.40	64	29.10	74	11.90	-----	39.40	48
2	11:30am	19.70	63	30.60	61	18.80	-----	43.10	40
3	12:30pm	13.10	53	31.60	57	16.70	-----	49.10	28
4	1:30pm	17:30	55	32.30	57	19.40	-----	43.60	36
5	2:30pm	20.90	53	32.20	51	13.80	-----	40.30	30
6	3:30pm	13:70	54	31.70	52	14.90	-----	43.20	20
7	4:30pm	16.20	52	31.70	50	19.50	-----	36.10	38
8	5:30pm	13.70	74	31.50	55	12.60	-----	30.80	44
9	6:30pm	16.90	59	30.10	55	13.00	-----	29.00	46
From 6:30pm-6:30am No Reading Was Taken									

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10	7:30am	10.40	60	27.20	70	14.00	-----	27.50	70
11	8:30am	2.40	80	27.60	69	6.20	-----	32.30	62
12	9:30am	2.40	85	28.00	68	5.50	-----	40.80	38
13	10:30am	3.00	84	29.20	65	8.40	-----	46.30	24
14	11:30am	3.00	84	30.00	60	15.00	-----	43.30	21
15	12:30pm	5.10	85	31.20	57	26.00	-----	41.80	33
						1:05pm = 29.00 Melted Out At Exact 1:05pm		41.20	33
16	1:30pm	4.60	85	32.00	50	-----	-----	-----	-----
17	2:30pm	5.00	83	32.00	48	-----	-----	-----	-----
18	3:30pm	6.30	84	31.80	44	-----	-----	-----	-----
19	4:30pm	12.70	92	32.00	42	-----	-----	-----	-----
20	5:30pm	17.10	90	30.90	45	-----	-----	-----	-----
21	6:25pm	19.70	95	30.50	47	-----	-----	-----	-----
22	Melted Out Exactly 6:25pm					-----	-----	-----	-----

Table 2: Temperature And The Relative Humidity Results For The Fifty Percent (50%) Of Ice Used For No Load Test.

S/No	Inside Laboratory(Room Condition)				Outside Laboratory(Ambient Condition)				
	Time (Hr)	In(Space Within The Box)		Out(Ambient)		In(Space Within The Box)		Out (Ambient)	
		T _{ai} (°c)	Rh _i (%)	T _{ao} (°c)	Rh _{ao} (%)	T _{bi} (°c)	Rh _{bi} (%)	T _{bo} (°c)	Rh _{bo} (%)
1	5:30pm	18.20	55	30.40	64	15.10		29.10	40
2	6:30pm	7.70	68	29.40	72	8.50		24.30	56
3	7:30pm	4.80	76	28.10	69	6.10		22.90	66
From 7:30pm-6:30am No Reading Was Taken									
4	7:30am	19.10	53	27.20	64	16.10		29.10	59
5	8:30am	9.40	75	27.30	64	18.90		36.90	40
6	9:30am	9.50	80	27.40	64	20.70		30.20	56
7	10:30am	11.60	84	28.80	63	-----		-----	-----
8	11:30am	14.60	91	29.70	59	-----		-----	-----
9	12:30pm	15.50	92	30.00	59	-----		-----	-----
10	1:30pm	16.10	92	30.50	58	-----		-----	-----

Table 3: Temperature And The Relative Humidity Results Of The 25:50% Ice To Fish Ratio Used For Load Test Experiment.

S/No	Inside Laboratory(Room Condition)				Outside Laboratory(Ambient Condition)					
	Time (Hr)	In(Space Within The Box)		Out(Ambient)		In(Space Within The Box)		Out (Ambient)		
		T _{ai} (°c)	Rh _i (%)	T _{ao} (°c)	Rh _{ao} (%)	T _{bi} (°c)	Rh _{bi} (%)	T _{bo} (°c)	Rh _{bo} (%)	
1	10:30am	19.40	70	30.10	75	18.00	70	40.30	50	
2	11:30am	18.70	71	31.60	62	16.80	68	44.20	42	
3	12:30pm	18.10	60	32.60	60	15.00	65	50.10	29	
4	1:30pm	17.30	58	32.00	50	19.40	57	45.60	38	
5	2:30pm	14.80	56	36.80	36	22.40	65	34.00	40	
6	3:30pm	15.40	67	31.30	42	15.90	61	39.70	20	
7	4:30pm	16.10	52	30.70	45	11.20	59	32.80	24	
8	5:30pm	22.10	49	30.20	47	10.50	57	31.20	35	
9	6:30pm	17.60	46	29.60	49	8.80	82	27.40	45	
10	7:30pm	3.30	74	28.90	51	8.30	84	22.70	70	
From 7:30pm-7:30am No Reading Was Taken										
11	8:30am	15.00	55	27.40	55	15.00		31.90	56	
12	9:30am	6.80	79	28.40	65	12.90		34.60	58	
13	10:30am	6.80	83	29.70	56	14.70		47.10	28	
14	11:30am	7.50	83	29.60	56	17.00		48.20	20	
15	12:30pm	7.80	82	30.50	53	18.20		43.80	27	
16	1:30pm	8.40	84	31.30	49	20.20		39.40	31	
17	2:30pm	8.50	85	31.50	47	21.40		49.10	20	
18	3:30pm	8.80	86	31.70	44	22.60		45.00	20	
19	4:30pm	9.60	88	31.50	44	23.20		47.30	20	
20	5:30pm	9.50	92	31.30	46	22.40		34.10	30	
21	6:30pm	9.30	94	30.50	50	21.90		29.40	42	
22	Melted Completely At 7:45pm					Melted Completely At 6:50pm				

Table 4: The Results Of Temperature And Relative Humidity Of The 50:50% Ice To Fish Ratio Used For Load Test Experiment

IV. Conclusion And Recommendation

During The Course Of This Experiment, The Iced-Fish Box As Show In Fig. 1 Above Was Found To Be A Simple, But Cost Effective Technology That Preserved That Fresh Caught Quality Of Fish And Allow For Temporary Transport And Storage Of Fish. The Results From The Study On The Use Of This Technology For Short Time Cool Storage Of Fish Has Been Found To Be Effective Due To Its Semi-Air-Tight Nature, And It Ability To Enhance Uniform Distribution Of Coldness Oozing Out From The Ices Within The Box And Therefore Keeping The Stored Fishes Within It Moist And Fresh, For A Reasonable Number Of Days.

Conclusively, Due To The Effectiveness Of This Technology To Maintain Safe Temperature For Short Time Cold Storage Of Fish, The Capacity Of The Box Should Be Increase So That More Fish Can Be Collected For Storage, Thereby Reducing The High Rate Of Spoilage Warranted By Poor Storage System.

The Execution Of The Project Afford Us The Opportunity To Discovered The Need For An Improvement In The Area Of Water Letting Out System Of The Box, This Is Because, It Was Noticed That After Some Hours Into The Experiment, Water Were Observed To Settled At One Side Of The Box Which Was Believed To Affect The Duration Of Melting Of The Ice In The Boxes. Increasing The Water Letting Outlet At The Base Of The Box Or Creating A Better Canal System (Slightly Sloping Down A Bit For Proper Draining Of The Melting Ice) Could Bring This Under Control. In Case, Fortunes Afford Us The Opportunity To Envisage Another Experiment On The Performance Of The Boxes, A Powerful Thermo Hygrometer That Is Sensitive To Read Negative Temperature Will Be Employed. The Fish Boxes Should Be Tightly Closed During The Experiment Proper.

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