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Comparative study on organoleptic, microbiological and chemical qualities of dried fish, Goldstripe Sardinella(*Sardinella gibbosa*) with low salt levels and spices

S.G.L.I. Nuwanthi[b], S.S.K. Madage[a*], I.G.N. Hewajulige[a], R.G.S. Wijesekera[b]

[a]*Food Technology Section, Industrial Technology Institute, 363, BauddhalokaMawatha, Colombo*
[b]*Department of Aquaculture and Fisheries., Faculty of Livestock Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, 60170, Sri Lanka.*

Abstract

Dried fish is very important component in Sri Lankan fishery productswhile current domestic production is estimated at around 40,000 tons per year. Generally, dried fish production in Sri Lanka is based on traditional methodology where 30% of salt is used averagely. Use of excess amount of salt can have negative health effects. Therefore production of dried fish with low salt is very important.Accordingly, partial substitution of salt with alternative substances can be done. Current study aimed at evaluating the effect of low levels of salt and combined effect of low salt and spices on quality of dried fish. The study was carried out using eviscerated and cleaned up GoldstripeSardinella with 0% (T1), 5% (T2), 10% (T3) salt levels and two different combinations of salt and spices (1%salt with 0.2%turmeric, 0.5%chlli, 0.5%pepper (T4) and 2%salt with 0.2%turmeric, 0.2%chlli, 0.2%pepper (T5)). Hot air dehydrator (65-70 ^{0}C) was used for fish drying. Chemical (moisture, water activity (a_w), Total volatile nitrogen (TVN), and sodium chloride), physical (texture and rehydration), microbiological (APC, mould and yeast count and coliform count) properties and sensory attributes of experimentally prepared dried fish were investigated. The chemical parameters for all treatments were significantly different ($p<0.05$) while physical parameters were not ($p>0.05$). T2 indicated the best chemical quality. The values for moisture, a_w, sodium chloride, TVN, texture and rehydration for T2, were 11.6584±0.03, 0.591±0.002, 12.43±0.15, 59.43mg/100g±12.86, 1.54kg±0.14 and 12.70±3.54 respectively. T2 and T3 had least microbial counts while T1 and T5 had highest microbial count. But T5 had highest scores for all sensory attributes indicating consumer preference for low salt and spicy taste regardless of high TVN content and poor microbial quality.Therefore it is essential to improve the methodology to enhance the quality of low salt and spices added dried fish.

**Corresponding author (Samantha@iti.lk)*

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1. Introduction

Sri Lankan fisheries sector has shown growth in increasing trend during the past decade. Accordingly the total fish production of the country was 486,170 Mt in 2012[4]. Dried fish is very important component in the Sri Lankan fishery production. Traditionally, dried fish represents a low cost source of high quality protein to the population with low income[6]. About 10% of the total marine fish landings are used for production of dried fish[3]. Drying is often used in combination with salting for additional preservation. Traditionally used proportion of salt is 3kg per 10kg of dressed fish prepared for salting. Any over use of salt in dried fish production creates economic and marketing costs and serious health burden.

According to the Industrial Technology Institute (ITI) findings, salt of dried fish samples from the markets are ranged from 14.05% to 17.41%. According to the Sri Lanka Standard accepted maximum salt content is 12% on dry basis. Consequently existing quality of the dried fish in local market is not appropriate for the human consumption. High levels of sodium consumption contribute to increased blood pressure in the population, and a consequent higher risk of cardiovascular and renal disease. Because of the positive correlation between sodium intake and the incidence of hypertension in old people and those with hypertension and diabetes, there is a tendency to reduce sodium content by substituting part of Sodium Chloride (NaCl) by other substances[5]. For that purpose Potassium lactate, potassium Chloride and spices can be used. Due to modern trends consumers adopt towards the consumption of foodstuffs containing no chemical preservatives, food products with natural additives have become popular. Accordingly spices are good natural alternative to partial substitution of salt in dried fish, as spices able to retard the microbial growth[7]. Accordingly dry fish production with low salt has become a critical requirement for public health security. Therefore objective of this study was to determine the potential of use low levels of salt with spices to produce low salted dried fish.

2. Methodology

Study was conducted at Fish Processing Lab of Food Technology Section in Industrial Technology Institute (ITI). Fresh Goldstriped Sardinella (*Sardinella gibbosa*) was collected from Peliyagoda Central Fish Market. Fish were handled at chilled condition and stored in -18 ^{o}C until experiment is conducted**.**

2.1 Sample preparation

Thawed GoldstripeSardinella were eviscerated, descaled and washed in running tap water for sample preparation for the experiment. Dried fish were prepared with three different levels of salt (0%(T1), 5%(T2), 10%(T3)) and two different combinations of salt and spices (1%salt with 0.2%turmeric, 0.5%chilli, 0.5%pepper(T4) and 2%salt with 0.2%turmeric, 0.2%chilli, 0.2%pepper(T5)) by following dry salting. 10% salt was used as the maximum salt percentage as it was the lowest salt percentage that provides the preferable quality attributes according to the previous ITI studies. Three spices that most commonly used in fish preservation were selected in two different levels that are compatible with consumer preference.
Samples were kept overnight for curing. Drying of fish was carried out at 65-70 ^{o}C in hot air dehydrator (Mitchel Dryer, Pratchill Bros Ltd, UK) for 17 hours until moisture content of dried fish sample reduce to about 12%. Chemical, physical, microbiological and sensory attributes were analyzed to compare the effect of law salt concentrations on quality of dried fish.

2.2 Chemical analysis

Moisture content was determined using oven dry method according to the AOAC 950.46 (2002). Dried fish samples were analysed for Water activity by using water activity meter (Series 3 TE, AquaLab®, USA) at 26 ^{0}C. TVN was determined according to the method described by Larson (1991). Dried fish samples were analysed for Chloride content according to the AOAC official method 437.09.

2.3 Physical analysis

Firmness was determined using Texture analyzer (GS25, GUSS texture analyzer, United States of America). Rehydration was analyzed by following procedure described by Aranda, et al.,[1].

2.3 Microbiological analysis

Total Plate Count, Yeast and Mold Count and Coliform were done following the SLS 516: Part 1: 1991 microbial test method, SLS 516: Part 2: 1991microbial test method and SLS 516: Part 3: 1991 microbial test method respectively.

2.4 Sensory evaluation

All dried fish samples were fried at temperature of 160-180ºC for 2 minutes in coconut oilto giveequal conditions for all samples. Acceptance test was conducted with twelve trained panelist of ITI sensory panel. Each panellist was asked to evaluate the color, odor, texture, taste, appearance and overall acceptability of each sample by using five point hedonic scales.

2.5 Statistical analysis

Physical and chemical quality data was analyzed using General Linear Model (GLM) procedure of SAS statistical package. Results are presented with the mean and standard deviation of triplicates. Statistical analysis was conducted using MS Excel 2007 for graphical interpretations. Sensory results were evaluated using Friedman Test in Minitab 15.0 software at 95% confidence level (CL).

3. Results and Discussion

3.1 Physiochemical analysis

Table 01: The effect of different treatments on the chemical properties of dried *Sardinellagibbosa*

Parameter	Fresh Fish	0%salt T1	5% salt T2	10%salt T3	1% salt +Spices T4	2% salt +Spices T5	Probability
Moisture (%)	$70.41^{a} \pm 1.88$	$12.71^{c} \pm 0.02$	$11.66^{c} \pm 0.03$	$14.38^{b} \pm 0.04$	$11.04^{d} \pm 0.03$	$9.16^{e} \pm 0.03$	SD(P)> 0.0001
a_w	$0.987^{a} \pm 0.004$	$0.675^{b} \pm 0.003$	$0.591^{c} \pm 0.003$	$0.6690^{b} \pm 0.000$	$0.555^{d} \pm 0.001$	$0.539^{e} \pm 0.013$	SD(P)> 0.0001
TVN (mg/100g)	$41.58^{d} \pm 6.55$	$67.36^{c} \pm 0.00$	$89.73^{b} \pm 0.00$	$59.43^{b} \pm 12.87$	$179.37^{a} \pm 0.00$	$186.52^{a} \pm 12.92$	SD(P)> 0.0001
Salt %	$0.296^{f} \pm 0.017$	$0.762^{e} \pm 0.023$	$12.436^{b} \pm 0.157$	$17.7211^{a} \pm 0.157$	$3.689^{d} \pm 0.056$	$5.939^{c} \pm 0.077$	SD (P)> 0.0001

Rehydration	-	1.68± 0.15	1.56± 0.14	1.48± 0.19	1.72± 0.07	1.64± 0.04	NSD (p)< 0.2517
Texture (kg)	1.06± 0.09	12.81± 3.95	12.70± 3.54	14.92± 6.39	15.55± 5.13	11.99± 6.54	NSD(p)< 0.1014

Means in same raw with the same letter are not significantly different

Salt content in T3 (17.7211±0.1569) was significantly higher ($p<0.05$) than the T2 (12.4360±0.1569). Also salt content of T5 (5.9395 ±0.0768) was significantly higher ($p<0.05$) than the T4 (3.6895 ±0.0558). There was a general increment in salt content of the dried muscle than the muscle prior to drying in all the salt treated samples, as water removes during drying. According to the Sri Lanka Standard 643: 2007 (Specification for Dried Fish), recommended amount of salt percent is 12% (on dry basis). Fish samples treated with 5% comply standard. These results were not in agreement with previous study reporting that 5% salt and 10% salted dried fish that hot air dried at temperature of 55 ^{0}C had 5.47%±0.75 and 8.57%±0.76 salt respectively[2]. It may be due to higher weight loss in this study than previous study as fish were subjected to drying at 65-70 ^{0}C until moisture content reduces up to 12%. There was a significant difference ($p<0.05$) in moisture contents due to variation of salt concentrations. Moisture content in T3 was significantly higher ($p<0.05$) than T4 and T5. The rate of drying was comparatively slower in the case of highly salted fish, because it was partly dehydrated by the osmotic action of the salt prior to dry. The slow drying rate was due to the presence of salt which increased the water binding capacity of the fish tissue. This study is in agreement with a previous result. Suliemanand Allaahmed[8] mentioned that the overall efficiency of the four differently treated fish in sun drying in respect of rapidity as, Unsalted > Turmeric treated > Salt and Turmeric treated > Salt treated. According to the ITI findings, moisture content in dried fish obtained from different markets in Sri Lanka is ranged from 15.76±0.02% to 23.92±0.23%. It reveals that, although market samples contained higher salt content, there is a high probability of spoilage than experimentally prepared low salted dried fish. a_w of treated samples were significantly lower ($p<0.05$) than the a_w of fresh fish at 95% confidence level. There was a general reduction in a_w in all treated samples. After drying, all six samples of dried fish showed values below the maximum allowable level (<0.75) stipulated in the SLS standard.

Fresh *S.gibbosa* purchased from market for the study contained high level of TVN (41.6mg/100g). TVN of fresh fish sample was significantly lower ($p<0.05$) than treated sample. It indicates that during dried fish production TVN content has been increased. TVN of non-salted dried sample (67.3622±0.0000mg/100g) was low since the non-salted sample was not subjected to the curing process it was kept frozen until drying. All salted samples were kept in ambient temperature overnight for curing. There was a significant increase in TVN in low salted and spiced samples. There was a high probability for spoilage in 1% and 2% salted and spices added sample due to over exposure in ambient temperature during the curing. It indicates that a further research is needed in order to determine suitable duration for curing for such a product. Sample contained 10% salt had the lowest TVN (59.4mg/100g). These results are different with a previous study reporting that TVN of 10% salted milk fish was 36.63 ± 2.07 mg/100g[2]. It may be due to TVN values are affected by fish species, sex and age, location and catching season[6].

Rehydration and texture were not a significant factor for all treatments ($p>0.05$). There is an inverse relationship between water uptake and quantity of salt lost during rehydration. Usually, rehydration yields show an adverse relationship to curing yields, which is influenced by the condition of the raw material and salting methods.

3.2 Microbiological analysis

Table 2: The microbial counts for differently treated dried *S.gibbosa*samples

Treatment	APC/g	Yeast and mould count/g	Coli forms (MPN)/g
Raw fish	2500	0	4
0% Salted dried fish	uncountable	510	0
Spice+1% salted dried fish	13000	0	15
Spice+2% salted dried fish	43	uncountable	40
5% Salted dried fish	140	1330	0
10% Salted dried fish	78	30	0

APC was ranged from 43 (T5) to 13000 (T4) except in the non-salted sample (uncountable). T5 had uncountable yeasts and moulds. T3 had least yeast and mold and coliforms count as 30 and 0 respectively. Salt and spices added samples had higher number of coliforms (15MPN/g and 40 MPN/g) than the fresh fish (4 MPN/g). According to the SLS standard, acceptable limit of APC is $1\times10^{5.}$ According to that APC for all treated samples comply the standard except non-salted sample. T5 sample had uncountable yeasts and moulds. T3 had least yeast and mold and coliforms count as 30 and 0 respectively. There was a probability of yeast and mold contamination through spices used. Salt and spices added samples had higher number of coliforms than the fresh fish. T2 andT3 had the least microbiological counts complying with the standard.

3.3 Sensory analysis

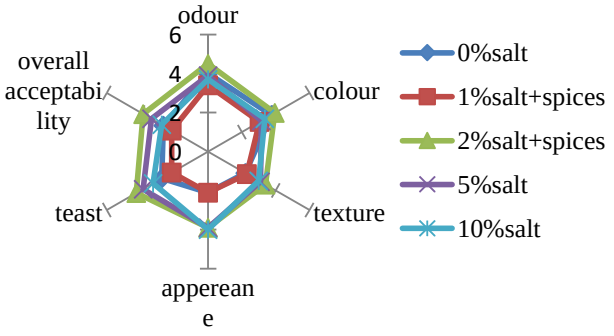

Figure 1: The effect of different treatments on sensory scores of dried *S.gibbosa*

Odour, colour, and texture were not able to make a significant difference while appearance, taste and overall acceptance were significantly ($p<0.05$) different for different treatments. T5 has obtained the more over preference than other fish samples for all sensory attributes. . Low salty taste may cause to this result. Next overall preference was for T2.Sulieman and Allaahmed (2012) mentioned the TVN value, was found to have an inverse relationship with the sensory score of the dried fish products, that is the sensory score decreased with the increment of the TVN value of the fish products. But in this research the highest preference was gone for the T5 with high TVN values. It may be due to the spicy taste and appropriate low salt taste. Although T4 has both spicy and low salty taste as T5, it had the lowest consumer preference. According to the comments of panellists, it was due to the higher toughness of that sample.

4. Conclusion

According to results, 5% salt added sample indicated the best chemical quality with preferable microbial and sensory attributes.Therefore, this research clearly shows that low salt percentage (5%) can be successfully used in dried fish production instead of existing high salt percentage.
2% salt and spices added sample also had the preferable moisture, water activity, salt content with highest scores for all sensory attributes while having high TVN content and poor microbial quality.It indicates consumer preference for low salt and spicy taste of dried fish. Therefore further researches are needed to improve the methodology and determine the correct curing time period to enhance the quality of low salt and spices added dried fish.

References

1. Aranda ID, Casas EV, Peralta EK, Elauria JC. Drying Janitor Fish for Feeds in Laguna Lake to Mitigate Pollution Potentials. Journal of Environmental Science and Management; 2010.13(2), pp27-43.
2. Hwang C, Lin C, Kung H, Huang Y, Hwang D, Su Y, Tsai Y. Effect of salt concentrations and drying methods on the quality and formation of histamine in dried milkfish (*Chanos chanos*). Food Chemistry journal ;2012. 135: pp839-844.
3. Ministry of Fisheries and Aquatic Resource Development, (2013a) Fisheries statistics (2013). Ministry of Fisheries and Aquatic Resources.
4. National Aquatic Research Resources and Development Agency – NARA (2012) Fishery Industry outlook.
5. Osheba AS. Technological Attempts for Production of Low Sodium Smoked Herring Fish (Renga). Advance Journal of Food Science and Technology ;2013.5(6), pp695-706.
6. Petrus PH, Suprayitno E, Physicochemical characteristics, sensory acceptability and microbial quality of WadiBetok a traditional fermented fish from South Kalimantan, Indonesia. International Food Research Journal ;2013.20(2), pp933-939.
7. Prasad MM, Seenayya G. Effect of spices on the growth of red *Halophili ccocci* isolated from salt cured fish and solar salt. Food Research International journal ;2000. 33: pp793-798.
8. Sulieman HMA, Allaahmed AAA. Effect of Antimicrobial Properties of Pepper Fruits on Some Spoilage Organism of Sudanese Wet-Salted Fermented Fish (Fassiekh) Product. World's Veterinary Journal ;2012.2(1), pp05-10.