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Food Ration: Tinola in a Cup with Dehydrated Rice

JINGCO, Freya Gay A. [1]; SALUNGA, Anna Dominique T.[2]

[1] 0000-0001-7951-6541; Bulacan State University. City of Malolos, Bulacan, Philippines. freygay.jingco@bulsu.edu.ph.
[2] 0000-0002-2005-4773; Bulacan State University. City of Malolos, Bulacan, Philippines. Annadominique.tallara@bulsu.edu.ph.

A B S T R A C T

Food rations are commonly used by the military during their mission. It is a calculated meal that is ready to eat. It usually comes in foil packs. The Philippines is one of the countries located in the Pacific region that commonly experience storms that often cause people to evacuate from their homes. Relief goods are given to those who are affected. This research aims to create a food ration that is healthier and easier to prepare as an alternative to relief goods distributed during calamities. The product that is being developed is under the category of processed food and ready- to-eat. Processed food contains sodium while chicken in which is the source of protein. Hence, these two nutrients are included in the study. Experimental results show that dehydration of chicken using electric dehydrator for 8 hours retains nutrients and eliminated moisture that is considered as the medium for microbiological growth. The final sample of dehydrated chicken has 0.85 water activity and categorize as intermediate moisture content, there is less chances of microbiological growth. While for dehydrated rice final sample the water activity is 0.86, under intermediate moisture content. The dehydrated chicken and rice contain nutrients that are necessary for the category of food ration that is given in situations that have limited water and energy that are needed in cooking.

RESUMO

As rações alimentares são normalmente utilizadas pelos militares durante a sua missão. Trata-se de uma refeição calculada que está pronta a comer. Geralmente vem em embalagens de alumínio. As Filipinas são um dos países situados na região do Pacífico que sofrem frequentemente tempestades que obrigam as pessoas a abandonar as suas casas. São distribuídos bens de socorro às pessoas afectadas. Esta investigação tem como objetivo criar uma ração alimentar mais saudável e mais fácil de preparar, como alternativa aos produtos de socorro distribuídos durante as calamidades. O produto que está a ser desenvolvido insere-se na categoria de alimentos transformados e prontos a comer. Os alimentos transformados contêm sódio e o frango é a fonte de proteínas. Por conseguinte, estes dois nutrientes são incluídos no estudo. Os resultados experimentais mostram que a desidratação do frango utilizando um desidratador elétrico durante 8 horas retém os nutrientes e elimina a humidade, que é considerada como o meio de crescimento microbiológico. A amostra final de frango desidratado tem uma atividade de água de 0,85 e é classificada como um teor de humidade intermédio, havendo menos probabilidades de crescimento microbiológico. No caso da amostra final de arroz desidratado, a atividade da água é de 0,86, o que corresponde a um teor de humidade intermédio. O frango e o arroz desidratados contêm nutrientes que são necessários para a categoria de ração alimentar que é dada em situações em que a água e a energia necessárias para cozinhar são limitadas.

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Introduction

Food rations are commonly used by the military during their mission. It is a calculated meal that is ready to eat. It usually comes in foil packs. According to WHO, a standard food ration should be provided to every beneficiary without distinction. Population sub-groups with obvious additional nutritional requirements (e.g. malnourished children) may require an additional ration over and above the standard basic ration. The Philippines is one of the countries located in the Pacific region that commonly experience storms that often cause people to evacuate from their homes. Relief goods are given to those who are affected. The effect of the calamities will take several days to weeks to clear leaving some families to stay in the evacuation area. There are limited water, electricity, and cooking needs at the evacuation site. Canned goods, noodles, and other processed foods are given to the affected families. These foods are high in sodium.

A common comfort dish which is a native soup from the Philippines is Chicken Tinola. It is rustic Filipino chicken soup that is warm, gingery, and aromatic. It is noted for its restorative and healing properties, which include aiding in the recovery from cold and flu symptoms. Additionally, it can ease cold, sore throats, and congestion and the ginger and garlic help us naturally cure any sniffles we may get. It is a wholesome Filipino soup that is rich in vitamins and protein. In addition, it is nutritious, particularly when you are feeling ill. The chicken gives us the protein and includes all of the key amino acids the body needs to create muscle, making it a complete protein. Vitamins A, C, and potassium are found in vegetables such as green papaya, kale, squash, and malunggay leaves. Fiber can be found in the leaves of malunggay and green papaya. Malunggay leaves are a good source of antioxidants, which can help combat free radical damage.

Food can be preserved by dehydrating it, which lowers the amount of water in it and increases its shelf life. Grain moisture content is lowered by drying to a level suitable for storage. One further benefit of dehydrating rice is that it can be transported across greater distances and stored for a longer period of time. This research aims to create a food ration that is healthier and easier to prepare as an alternative to relief goods distributed during calamities. The product that is being developed is under the category of processed food and ready- to-eat food.

Microbiological Characteristics of dried meat

Microorganisms in dried meat and meat products are significant in determining the quality of the products and process. Many attributed factors affect the microbiological activities in dried meat, like the aw values, which indicate the relative moisture balance or available water ration that provides conditions for microorganism growth. The spoilage may

influence by pH changes (>5.8) or oxygen contamination. (Mediani,A.et.al.,2022)

Water Activity

The physically determining factor for both processes is the water activity, aw, of the packed product, which is defined as the ratio of the fugacity of the water above the given food product and the fugacity of pure water under the given conditions of temperature and pressure. With good accuracy, its value is given by the ratio of the equilibrium water partial pressure created by the product in a closed environment to the saturation water vapor pressure in the air for the same conditions. In equilibrium conditions, the water activity of a product will have a direct relation to its water content, although it cannot be expected that both values be equal. For low-moisture products, the water content is usually given as the ratio of the mass of the water (H2O) in a given product to the mass of the dry product. (Singh, P.et.al, 2017)

Shelf-life

Shelf life can be defined as the finite length of time after which the product stored under specific packaged and environmental conditions becomes unacceptable. A description of the main steps to study food shelf life and to define it based on simulation tests is reported. The first part of the article describes the main processes responsible for the deterioration of food and the main critical quality parameters related to the product or environment. Then, the main quality indexes and how to determine the critical value of the quality index to establish the end of the shelf life are described.

During shelf life, a set of chemical, physical, and biological reactions can occur in food products decreasing their safety and quality until the product is considered unacceptable. This phenomenon is known as food spoilage and is caused mainly by microorganisms, enzymes, and physical and chemical degradation which are critically associated with the former intrinsic and extrinsic factors (Torrieri, 2016).

Storage

In the study of Thuy, N.M. et.al (2020) mentioned that the storage of products is important and necessary. Packaging containing the products to be studied, zipper reclosable aluminum bags double-sided were selected. After five months of storage, the moisture content and water activity of the product contained in zipper reclosable aluminum bags double-sided remain unchanged, respectively.

Physicochemical Properties of Chicken

The findings in the study of Dominguez-Nino, A.et.al (2020), that the moisture and water activity of chicken samples were reduced sufficiently to ensure microbiological and chemical stability. Based on the results, the short dehydration cooked samples. According to the results, the short time was observed using a forced convective dehydration time was observed using a forced convective dehydrator (7hr) than in natural convection (12h) at 65 °C.

The fat content in chicken breast samples increased at dehydration temperatures of 45°*C* and 55 °C but a decrease in fat content was detected at 65 °C in both processes. The result suggested that the protein content of chicken breast has not been affected by using low dehydration temperatures and can be used as a food ingredient.

Dehydrated chicken breast meat is a food with high protein content and low fat which can be combined with other dehydrated food and be a principal ingredient in the preparation of different kinds of foods, it can be cooked directly and with additives such as flavoring it can be eaten as a snack. Due to its easy handling and prior sanitary control, it can be distributed in rural areas and supply food to hospitals, schools, nursing homes, and orphanages, to improve child nutrition and the domestic sector.

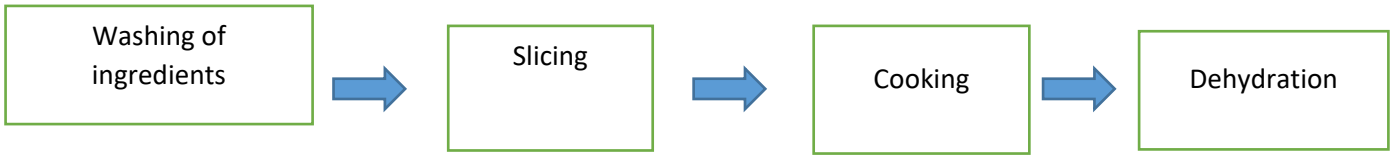
The general objective of this study is to develop a healthy and natural food ration as an alternative to relief goods distributed during calamities. For the specific objectives: (1) to formulate tinola food ration thru dehydration; (2) to provide nutrition facts of tinola food ration; (3) to analyze the safety of the tinola food ration based on the microbiological tests.

Materials and Methods

This research is an experimental study with trials for formulation. The control variables are type of chicken, rice, dehydrator and temperature of dehydration. The dependent variables are the total hours of dehydration, spices, cooking preparation, and salt.

Figure 1

Process flow of Sample Preparation



The steps in sample preparation are as follows: first, washing of the chicken, papaya and ginger and rice. Next step is the slicing of chicken breast. Then, cooking by sauteing the sliced chicken breast in 177 C temperature for 5 minutes. Then cooking by boiling with temperature of 100 C for 15 minutes of rice with a ratio of 1 cup of rice to 1 cup of water follows. Lastly, dehydration of the cooked sliced chicken breast for a maximum setting of 75 °C temperature for 8 hours and the dehydration of rice for a maximum setting of 75 °C temperature for 8 hours.

Figure 2 shows the dehydration process of chicken using a dehydrator with a maximum setting of 75 °C for 8 hours. A thermometer was used to check the accuracy of the temperature. The time when the sample was placed and time when dehydration process ends were noted.

Figure 2

Dehydration of chicken breast

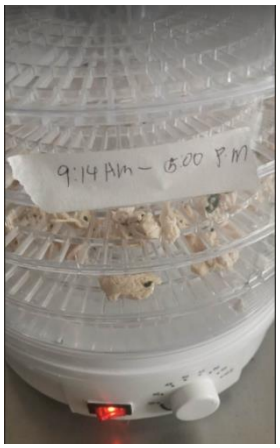


Figure 3 shows the dehydration process of rice using a dehydrator with maximum setting of 75° C for 8 hours. The time when the sample was placed and time when dehydration process ends were noted.

Figure 3

Dehydration of rice

Figures 4

Dehydrated Chicken Samples in vacuum packs

Dehydrated Chicken Samples sent to DOST Regional Analytical laboratory which is 500 grams Net weight per sample.

Figures 5

Dehydrated Chicken Samples in aluminum foil packs

Dehydrated Chicken Samples sent to Fast and Lipa Quality Laboratory is 200 to 300 grams Net weight per sample.

The control variables are the type of chicken, temperature of dehydrator and the number of hours of dehydration. The independent variables are spices, salt, cooking procedure, and additional ingredients. While the dependent variables are the water activity, ph, sodium, protein content and microbiological analysis of the dehydrated chicken. These will be the basis for the nutrient, microbiological analysis and shelf life of the product. The total amount of sample per test in DOST Regional Analytical laboratory is 500grams while for Fast and Lipa Quality Laboratory is 200 to 300 grams. The samples were sent in vaccum and aluminum foil packaging.

Table 1 shows the formulation of the tinola. C1 ingredients as listed in Table 2 are sliced chicken breast (soaked in brine solution 30 minutes, 0.5% teaspoon salt, 2.5% powdered

ginger, onion, and garlic, then sautéed in coconut oil. C2 sample includes 2 teaspoons salt,0.5%teaspoon each powdered ginger, onion, and garlic sautéed in coconut oil. And in sample C3, potato cubes 1% were pressured cooked in chicken broth. Sliced chicken breast with 2.5% grams ginger, garlic, and onion in bottle were placed in the broth and mashed potato then pressured cook high for 5 minutes.

Table 1

Initial Trial for Formulation of ingredients and cooking method for Tinola samples at 75C for 8 hours

Ingredients	C1	C2	C3
Chicken breast weight	88.7 gms	87.5 gms	92.6 gms
Salt	¼ tsp.	¼ tsp.	¼ tsp.
Brine solution (1 tsp.salt 1 cup liquid for 30 minutes)	with brine solution	without brine solution	without brine solution
Fresh Ginger, onion, and garlic	1 tsp. each		1 tsp. each
Powdered Ginger, onion, and garlic		1 tsp.	-
Sautéed	With 1 tsp. coconut oil	With 1 tsp. coconut oil	
Pressure cooked	-	-	5 minutes high
Potato	-	-	82.7 gms
Chicken broth	-	-	500 ml
Chicken breast weight after dehydration	24.4 gms	24.5 gms	20.6 gms

Note : C1 = sample chicken 1
C2 = sample chicken 2
C3 = sample chicken 3

Table 2 shows the three samples of Jasmine rice. As can be gleaned on the table, all three samples have the same ratio 1:1 of water and rice. DRA sample was dehydrated in 5.5 hours, while DRB sample was dehydrated in6 hours, and DRC sample was dehydrated in 10 hours.

Table 2

Formulation for dehydrated rice and duration of dehydrated rice at 50C

Ingredients	DRA	DRB	DRC
Jasmine Rice	1 cup	1 cup	1 cup
Water	1 cup	1 cup	1 cup
Total Number of hours of dehydration	5.5 hours	6 hours	10 hours

DRA= dehydrated rice sample A
DRB= dehydrated rice sample B
DRC= dehydrated rice sample C

Nutrient Analysis

Table 3

Nutrient Content of Tinola Sample in 8 hours dehydration with 75°C temperature

Parameters	Unit	Test Method	C1	C2	C3
Sodium	mg/100g	Flames AES	570	856	416
Protein	g/100g	Kjeldahl	73.0	66.8	66.5

Reference :

Official Method of Analysis of AOAC International 21st Edition, 2019

Single replication

Note : **C1** = sample chicken 1
C2 = sample chicken 2
C3 = sample chicken 3

As presented in Table 3, C1 sample has sodium content of 570mg per 100mg and 73g of protein, C2 sample contains 856 mg per 100g of sodium and 66.8 mg of protein, and C3 sample has 416 mg per 100 mg and 66.6 mg of protein per 100g.

Table 4

Proximate Analysis of Dehydrated Chicken Sample C3

Test Parameters	Results	Test Method
Moisture %	34.39	Gravimetric Method
Ash,%	1.94	Gravimetric Method
Crude Protein %	59.68	Kjedahl Method
Crude Fiber,%	0.21	Ankom Method
Crude Fat %	1.86	Solvent Extraction Method
Nitrogen Free Extract,%	1.92	-
pH	6.68	Electrometric Method

Reference : AOAC Official Methods of Analysis,20th Edition 2016

Single replication

Table 4 shows the result of the proximate analysis of the final sample which is the C3. It is composed of 59.68% of crude protein, 34.39% moisture, a ph of 6.68%, 1.94% ash, crude fat of 1.86%, and crude fiber of 0.21%. Results revealed that there is protein present in the dehydrated chicken and it is slightly high in moisture. This analysis is applied during formulation to determine the protein or energy source. (Sciencedirect) These analyses show the moisture, crude protein (total nitrogen), crude fibre, crude lipids, ash and nitrogen-free extract content of the sample.

Table 5

Proximate Analysis of Dehydrated Rice DRC

Parameters	Unit	Test Method	Results
Moisture	g/100g	Vacuum Oven Drying	4.89
Ash	g/100g	Ignition-Gravimetry	0.454
Fat	g/100g	Soxhlet Extraction	0.0364
Protein (Nx5.95)	g/100g	Kjeldahl	6.39
Carbohydrates	g/100g	By computation	88.2

Reference : AOAC Official Methods of Analysis AOAC,21th Edition 2019

Single replication

As shown in Table 5, dehydrated rice sample DRC has 4.89g moisture,0.453g of Ash, 0.0364 g of fat, 6.39g of protein, and 88.2 g of carbohydrates.

Table 6

Nutrition Facts of Tinola in a Cup

Nutrition Facts	Energy	Carbohydrates	Dietary fiber	Prot	Fat	Na	Ca	Fe	Vit. A	Vit. C
Chicken Serving per container 50 grams	149.74			33.2 g	1.86 g	399 gm				
Malunggay 1 gram	1.08	0.127	0.067	0.97 g	0.02 g	0.08	3.69	0.028	9.72	1.37
Sayote 1 gram	0.23	0.051	0.004	0.005	-	0.08	0.17	0.003	0.01	0.03
Luya	0.41	0.058	0.011	0.011	0.008	0.03	0.32	0.03	0	0.04
Rice Serving size per container 50grams Total calories 352 kcal Carbohydrates 88.2 grams Protein Total Calories 378.36 kcal	189.18	44.1		3.195						
Total	340.64	44.336	0.082	37.381	1.88	399.19	4.18	0.058	9.73	1.44
Percent Daily Values	(2530) 13.4	(75) 59.1	(20)	(57g) 65.5	(30)	(500) 79.8	(600)	(10.4)	(499)	(30)

(Based on FNRI PDRI Adults 19-29 years old Male)	*6%*	*0*	*4.1*	*7*	*6.26*	*3*	*0.39*	*0.55*	*1.94*	*4.8*

Table 6 shows the nutrition facts of tinola in a cup. The nutrients are divided into two groups the macro and micro. Included in the macro nutrients in the product being develop are the carbohydrates, protein, and fat. For the micro nutrients are vitamin A and C, sodium, calcium, and iron. The basis for the nutrition facts are the results form the proximate analysis of dehydrated chicken and rice. For malunggay (*Moringa oleifera*), ginger, and sayote nutrient is the FNRI Food composition table. As can be gleaned from the table, the product contains a total of 340kcalorie that is 13.46% of the daily recommended intake. While for carbohydrates is 44grams (59% in RENI), dietary fiber is 4.1 grams(4.1%), protein is 37.38grams(57g),fat is 1.88grams(6.26%),sodium is 399.19 mg (79.83%), calcium is 4.18mg(0.39%),iron is less than 1 mg(less than 1%), vitamin A is 9.73mg(1.94%), and vitamin C is 1.44mg (4.8%).

Microbiological Analysis

Microbiological organisms contribute to the quality and safety of foods. The microorganism that is common in chicken is *salmonella*. While *e.coli* is an indicator of proper food preparation and safe water source during preparation. Yeast and molds are microorganisms that are indicators of proper dehydration, packaging, and storage of the product. Table 7 shows the microbiological analysis of the dehydrated chicken samples.

Table 7

Microbiological Analysis of Samples

Parameters	**Test Method**	**Results**		
		C1	**C2**	**C3**
Total Plate Count,CFU/g	Pour Plate	2.4x105	650	<250(EST)
E.coli,MPN/g	IMVC	<1.8	<1.8	<1.8
Salmonella Detection,per 25g	Conventional-Presumptice	Negative	Negative	Negative
Yeast and Mold Count,CFU/g	Spread Plate	<10 (Est)	<10 (Est)	<10 (Est)

Note : CFU/g = Colony-Forming Unit per gram MPN/G=Most Probable number per gram

(Est.)=Estimated

Reference : U.S. Food and Drug Administration (FDA).Bacteriological Analytical Manual Online

In Table 7, the C1 sample has a total plate count of 2.4x105 Count CFU/g,<1.8MPN/g of *e.coli*, negative in *Salmonella* per 25g, and <10 yeast and mold count; C2 sample results show it has 650 CFU/g of total plate count, <1.8g *E.coli* per 25g, negative in *Salmonella* per 25g, and <10 yeast and mold count; while sample C3 results are <250 total plate count, negative in *Salmonella* per 25g, and <10 yeast and mold count. All of the results passed the standard for microbiological standards indicators. This shows that during the preparation and dehydration process there are no contamination occurred.

Moisture content is a factor for possible growth of pathogens. High-moisture foods are characterized by a water activity above 0.9, which may already be reached if a product's water content is 14 g H2O/100 g. (Singh,P.et.al) Foods can be categorized according to Labuza (1984) as dry((aw = 0.25), low moisture(0.25 < aw < 0.6), intermediate(0.6 ≤ aw ≤ 0.9), and high moisture content(aw > 0.9).

Table 8

Water activity of dehydrated chicken

Parameters	Unit	C1	C2	C3
Water Activity	aw	0.65*	0.88*	0.856@

Reference :

*Method TM-235With Reference to Rotonic Hygrolab Bench Top Humidity Temperature Indicator Instructional Manual

@Aqualab Pre Water Activity Meter Manual Version 2

The water activity test as shown in Table 8 for the C1 sample is 0.65aw, the C2 sample is 0.88aw, and for C3 0.85 aw. The results indicate that all the samples are under the category of intermediate water activity. This means that water activities between 0.6 and 0.9 will be dependent on the ambient climatic conditions. Regarding microbiological growth (such as in FSAI 2011), intermediate moisture products have a water activity between 0.85 and 0.92 and are characterized by a non-negligible—but still moderate—the risk of microbiological deterioration (Sigh, P.et.al.,2017).

Table 9

Water activity of dehydrated rice

Parameters	Unit	Result			
Water Activity	Aw	DR1*	DR2*	DR3@	Commercially Available Ready to Eat Rice in pack@
		0.97	0.97	0.861 @25.6c	0.982@25.4C

Note:

*Method TM-235With Reference to Rotonic Hygrolab Bench Top Humidity Temperature Indicator Instructional Manual

@ Aqualab Pre Water Activity Meter Manual Version 2

In table 9 shows results of the water activity test for dehydrated rice. As can be gleaned from the table, shows that samples DR1 and DR2 have a water activity of 0.97 while sample DR3 has 0.861 *aw*. For comparison purposes, commercially available ready-to-eat rice was also subjected to a water activity test. Although the product is ready to eat, the shelf life is 6 months. It shows that it has 0.98 *aw* which indicates that it is under the high moisture content.

The dried chicken and rice in this study provide 340 kcal, or 13.46% of the daily recommended intake, of nutrients, 44 grams of carbohydrates (59% in RENI), 4.1 grams of dietary fiber (4.1%), 37.38 grams of protein (57g), 1.88 grams of fat (6.26%), 399.19 mg of sodium (79.83%), 4.18 mg of calcium (0.39%), less than 1 mg of iron (less than 1%), 9.73 mg of vitamin A (1.94%), and 1.44 mg of vitamin C (4.8%) are all required for the type of food ration that is provided when there is a shortage of water and energy needed for cooking.

Conclusion

Experimental results show that dehydration of chicken using electric dehydrator for 8 hours retains nutrients and eliminated moisture that is considered as the medium for microbiological growth. The final sample of dehydrated chicken has 0.85 water activity and categorize as intermediate moisture content. This means that there is less chances of microbiological growth but the packaging material is important in the of shelf life of the dehydrated chicken. While for dehydrated rice final sample the water activity is 0.86 that also under intermediate moisture content.

This study was supported by the findings of Dominguez-Nino, A.et.al (2020), the moisture and water activity of chicken samples were reduced sufficiently to ensure

microbiological and chemical stability. Based on the results, the short dehydration cooked samples. Dehydrated chicken breast meat is a food with high protein content and low fat which can be combined with other dehydrated food and be a principal ingredient in the preparation of different kinds of foods, it can be cooked directly and with additives such as flavoring it can be eaten as a snack. Due to its easy handling and prior sanitary control, it can be distributed in rural areas and supply food to hospitals, schools, nursing homes, and orphanages, to improve child nutrition and the domestic sector.

In this study, the dehydrated chicken and rice contain nutrients that are necessary for the category of food ration that is given in situations that have limited water and energy that are needed in cooking. Due to time constraints the shelf life study was not included in the study.

Recommendation

To determine how long the tinola with dehydrated rice maintains its best quality, further test on the shelf life is recommended.

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