DEVELOPMENT OF A HIGH PROTEIN DRINK USING POULTRY EGGS

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Abstract

Milk and egg are two most commonly used livestock products in the world. They contain high amount of proteins and lipids which are essential for human growth. Objective of this research is to develop a new egg based liquid product which can supply protein and energy for both young and adults. The recipe was developed with different preliminary trials to identify the best combinations of milk powder, egg and sugar. Cloves and nutmeg were used as the spices to give the sparkling taste of the product. To finalize the recipe sensory evaluation was carried out with 30 untrained panelists. pH, lipid oxidation and microbiological studies were carried out to determine the keeping quality. According to the sensory evaluation results the final product contains 10% (w/v) sugar; 25% (w/v) egg and 10% (w/v) of full cream milk powder. There were significant difference in organoleptic properties in the level of egg ($P<0.05$) but no significance deference in sugar level with 15% (w/v) ($P>0.05$). 0.01% (w/v) nutmeg gave better organoleptic properties than combinations ($P<0.05$). Keeping quality analysis showed the developed product can be stored over 05 days under refrigerated condition. Egg white incorporated product can be introduced to older people and whole egg incorporated drink can be introduced to younger people as high energy drink.

***Keywords**: Egg Drink, Keeping Quality, Energy, Protein*

INTRODUCTION

Eggs are the food that provides all nutrition to the human. It is one of the few foods that are used throughout the world. Nutritional value of the whole egg contain water (75%), proteins (12%), lipid (12%), carbohydrate and mineral (1%) (Huopalahti et al., 2007; Abeyrathne et al., 2013). On the other hand egg contains all essential amino acids. Bioavailability of these proteins and other nutrients are very high among eggs when compared with other animal protein sources (Stadelman and Cottrill, 2001). Also proteins present in egg white as anti-microbial- anti-oxidative, anti-cancer and many other important properties (Abeyrathne et al., 2013). It also contains other nutrients like cholesterol and phospholipids which are important to human life (Lee et al., 2014). Egg production in the world has increased over the years and China leading the way (International Egg Commission, 2013). But the egg industry was developed way back in 1865 in USA with pasteurized egg products and it is well established in many countries as one of the profit oriented livestock industry (Stadelman and Cottrill, 2001). There are many egg and egg based products in the world which include pasteurized eggs, egg powder and many other egg based products. Eggs are used in many other food industries due to its functional properties like foaming, binding and coloring (Mine, 2008).

Egg nog is rich, creamy beverage traditionally popular during the holiday season (Perry et al., 2009) and its not popular drink among Sri Lankan people. It is famous in countries like USA, Japan, Germany, England and France. It is made using whole egg, egg yolk or egg white and other main ingredients are milk, sugar and spices. Most famous spices are cinnamon (*Cinnamon verum*), nutmeg (*Myristica fragrans*) and vanilla. These ingredients may vary according to their culture. But, it is widely available only

few months out of the year. Another limitation of this product is that it cannot consume in large quantities due to high fat and protein content.

Sri Lanka is moving towards self-sufficient in eggs by the year 2020. Evan though there are many dairy, meats and fish based products in the local market no egg based products available. Therefore introducing such products can fill the gap in livestock product in the country. The objective of this research is to develop egg based pasteurized product which can be consume directly.

MATERIAL AND METHOD

Chicken eggs (medium size, brown eggs) were purchased from a local market. Full cream milk powder, salt, sugar and spices (nutmeg, clove, and cinnamon) were purchased from a local market. The experiment was carried at the Uva Wellassa University, Badulla, Sri Lanka.

Development of egg based drink

Egg drink was prepared using eggs, sugar, milk powder, salt, water and spices (vanilla, cinnamon and nutmeg). Preliminary trials were carried out with milk powder, water, sugar and egg to narrow down the suitable range for each ingredient in the final developed recipe. Product was heated at 60ºC for 3.5 minute to pasteurize the liquid mix. Fifteen untrained panelists were used to select the suitable range of each ingredient. Firstly, preliminary trail was conducted to find out the best egg level by changing the egg level in four treatments of 10%, 25%, 50% and 75%. With the results level of eggs were narrow down to four treatments, such as 25%, 37.5%, 50%, and 62.5%. After that, another sensory evaluation was carried out with 30 untrained panelists to finalize the most suitable level of eggs to incorporate in to the final product.

Then another set of preliminary trials were carried out to narrow down the best sugar level in the final product. Sugar level was changed from 0%, 5%, 10% and 15%. Control group is 0% sugar level. Then with 30 untrained panelists the optimum level of sugar was tested. Levels of full cream milk powder, vanilla were predetermined with some preliminary trials after considering the cost of production. Level of vanilla and salt level were selected according to the mouth feel.

Third set of trials were carried out to check the optimum levels of spices to add to the final recipe. Clove and nutmeg powder was used as the spices since in traditional egg nog nut-meg was used to give the sparkling taste. Therefore four treatments were prepared by varying ration between clove and nutmeg as 0.0:0.01%, 0.01:0.01%, 0.02:0.02% and 0.01:0.0% to selected the best combination of spices. Prepared samples were tested for its sensory properties with 30 untrained panelists.

As the final step of development of the recipe different forms of eggs were used. As the different forms whole egg, egg white and egg yolk were used with the predetermined levels. Sensory evaluations were carried out using to 30 untrained panelists for color, aroma, taste, mouth feel and overall acceptability.

Proximate analysis

Proximate analysis of the developed recipes was carried out in Veterinary Research Institute, Gannoruwa, Peradeniya, Sri Lanka. Moisture content, Ash content, Crude Protein and Crude fat content was measured with standard AOAC protocols.

Microbiological analysis

As for the keeping quality analysis *Salmonella* and *E. coli* count was measured. The EMD media use for identified the *E. coli* and XLD (Oxoid Ltd, UK) media for *Salmonella*. Method of detection was as fallowed with some modifications of SLS standards (SLSI, 1992).

1 ml sample was dissolved 9 ml of the Peptone water (Himedia Laboratories Pvt. Ltd, India). Its concentrate takes as 10^{-1}. Then 1 ml sample was taken from above sample and it also dilution in 9 ml of peptone water. Its concentrate takes as 10^{-2}. Again dilution serious was followed and prepared a 10^{-3} concentrate solution. The media was poured to the Petridis and kept few minute until it became set. Then one micro liter of the sample was taken from dilution sample (10^{-3}) by using Micro pipette. The drop was spread inside the media by using spreader and sealed well. These all things are done in Laminar flow cabinet. The sealed petridis were kept inside the incubator (Gemmy industrial Co., Taiwan) for 24 hours at 37ºC. Each sample consists with 3 replicate. The colonies were counted using colony counter (Galaxy 230).

Titratable acidity

Titration method was used to measure the acidity of the samples. 5 ml of the sample was titrated with a standard 0.1 N NaOH and colour change was measured. Acidity level was measured using the following equation.

$$\text{Titratable acidity} = \frac{N \times V \times W}{M \times 100}$$

N= Normality of NaOH
V= Volume of titrant
W=Equivalent weight of acid
M=Mass of the sample

Oxidative test

Oxidation of lipid was measured with some modifications. Samples for lipid oxidation assay was prepared by mixing 8 ml of egg sample, 0.5 ml of 0.2% ascorbic acid (Sigma-Aldrich, USA), 0.5 ml of 200 ppm Fe^{2+} ($FeSO_4$, Sigma) and 1 ml of distilled water. The samples were incubated at 37ºC for 16 hr. At the end of incubation, one ml of sample was transferred to a 15 ml falcon tube, added with 2 ml of thiobarbituric acid/ trichloroacetic acid solution (20 mM TBA/15% TCA) and 50 µl of 10% butylated hydroxyanisole in 90% ethanol, and then vortex-mixed. The mixture was incubated in a 90ºC water bath for 15 minutes to develop color. The sample was cooled in an ice bath for 10 minutes and centrifuged at 3,000 x g for 15 min at 5ºC. The absorbance of the solution was measured at 532 nm against a blank prepared with 1 ml of distilled water and 2 ml TBA/TCA solution. The amounts of TBARS were expressed as mg of malondialdehyde (MDA) per L of egg product. All experiments were carried out in three replicates.

Statistical analysis

Sensory data were analyzed using Minitab software version 15. Friedman non parametric statistical method was used at the 5% level of significance. Web diagrams and other charts were prepared using Microsoft Excel 2007.

RESULTS AND DISCUSSION

Several preliminary trials were carried out to narrow down the level of sugar, milk and level of eggs in the final recipe. Milk and egg contain high amount of proteins which are essential to growth and development (Stadelman and Cotterill, 2001; Campbell et al., 2007). Also they contain some essential vitamins like vitamin A, D, E and B group (Lee et al., 2014). Therefore use of eggs and milk in one product will give extra nutrients.

Preliminary trials were carried out to find the best levels of eggs. According to them level of eggs incorporation was narrow down to less than 25% (w/v) (data not shown). High level of eggs in the recipe gave negative sensory properties but home meal replacement (HMR) products are becoming popular among the western countries (Sim and Sunwoo, 2006). The condition in the country is very poor since

there are no products available in the market.

Then level of egg was reevaluated with 0% as the lowest and 50% (w/v) being the highest. With the results obtained from 30 untrained panelists 25% (w/v) was considered as the optimum level of eggs to be incorporated in the final recipe (Figure 1). In recent years processing of egg and eggs products were far behind most of food products such as dairy and meat (Mine, 2008). Most of eggs are used as raw or boiled and no products are available in the market. Therefore this can be a suitable product to introduce to the market.

Sensory evaluation of sugar level in the egg drink

Sugar is another main ingredient that is used in egg drink. Because it is directly affect to the taste of the final product. Figure 2 shoes the sensory evaluation results for the sugar level.

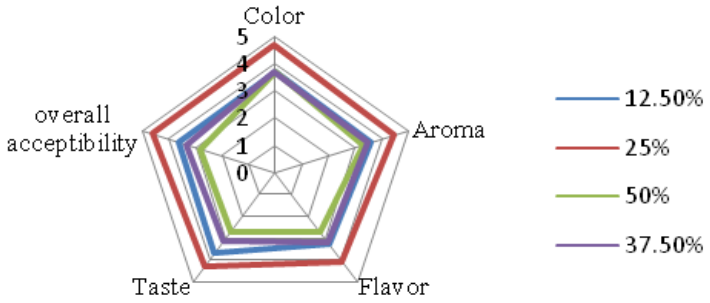

Figure 1: Web diagram of optimum level of eggs incorporated to the final recipe

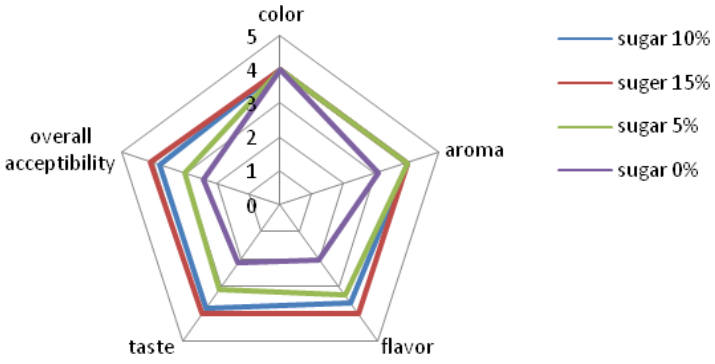

Figure 2: Web diagram of sensory evaluation for best sugar level

According to the Figure 2, 10% and 15 % (w/v) sugar incorporated samples did not show any significance deference between the organoleptic characters ($P>0.05$). Therefore after considering the cost of production, 10% (w/v) was selected as the most suitable.

Sensory evaluation of spices level and its combination

There were four types of spices, such as vanilla, clove, cinnamon and nut-meg which can be incorporated in egg based products (Agbogidi and Azagbaekwe, 2013). Past studies showed that 1% (w/v) vanilla was better compared to higher levels. But level of nut-meg and cloves were difficult to pre-determine since it vary according to the taste. Therefore another set of trial were carried out to finalize the suitable level. According to the figure 3, 0.01% nutmeg and 0% clove incorporated drink select as best one ($P<0.05$).

Sensory evaluation of the most suitable egg component

Finally most suitable source of eggs was determined by another sensory evaluation. According to the figure 4, egg white gave the best organoleptic properties from the rest ($P<0.05$). Therefore egg white can be used as the best protein source in the product. Such product can be introduced in to older people whereas whole egg incorporated product can be introduce to younger generation.

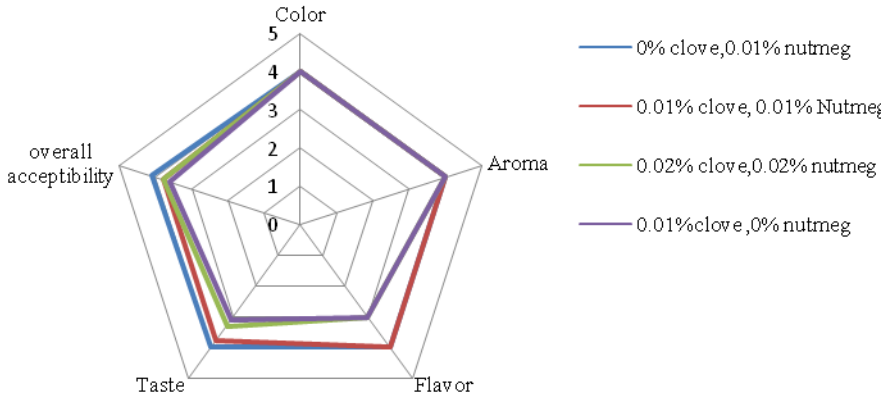

Figure 3: Web diagram of best level of Clove and Nutmeg in the final recipe

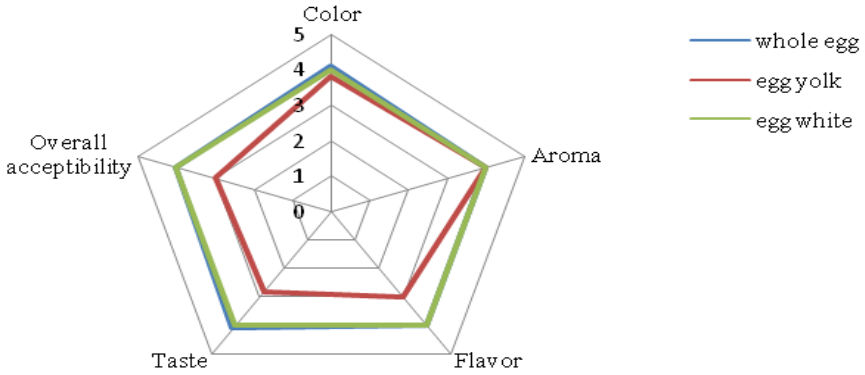

Figure 4: Web diagram of suitable egg component

Whole egg contains high level of proteins and cholesterol which are important for the growth and development of youth (Stadelman and Cotterill, 2001). Milk powder too contain essential proteins and other minor nutrients which also important to growth and development (Haug et al., 2007). So such products can be easily introduced the market with less conflicts.

Shelf life analysis

Acidity, lipid oxidation was measured to check the shelf life of the product. Protein and lipid oxidation may occur due to high protein and lipid contenting both in eggs and in milk (Stadelman and Cotterill, 2001; Haug et al., 2007). During the storage period there were no significant variation in pH in egg white incorporated product but the pH of whole egg incorporated egg drink was reduced from 7.0 in day 1 to 6.0 in day 10 (Figure 5). This may be due to formation of free fatty acids due to enzyme reaction during storage. According to Froning, 1986 pH value of the whole egg incorporated liquid is nearly 6-7 and pH value of egg white incorporated liquid product is nearly 7-8. Formation of triglyceride from egg yolk lipids may cause the reduction in pH during storage (Stadelman and Coterill, 2001). On the other hand titratable acidity of the two selected products showed significance difference.

The acidity change in egg white incorporated product showed very less variation while significance increase was observed in whole egg incorporated egg drink ($P>0.05$) (Figure 6). This complies with the free acid formation due to breakdown of egg lipids.

Lipid oxidation is one of the major problem related food products (Addis, 1986; Halliwell and Chirco, 1993). Egg yolk contains lipids which can be easily oxidized (Stadelman and Cotterill, 2001). Therefore checking the lipid oxidation is important. During storage period, level of malnoldihide was increased with storage at 4°C. The oxidative value is remaining same in first three days. After that it was increasing at an increasing level. It shows the spoilage quality of the product (Figure 7). The shelf life of the product is between 5-6 days without adding preservatives.

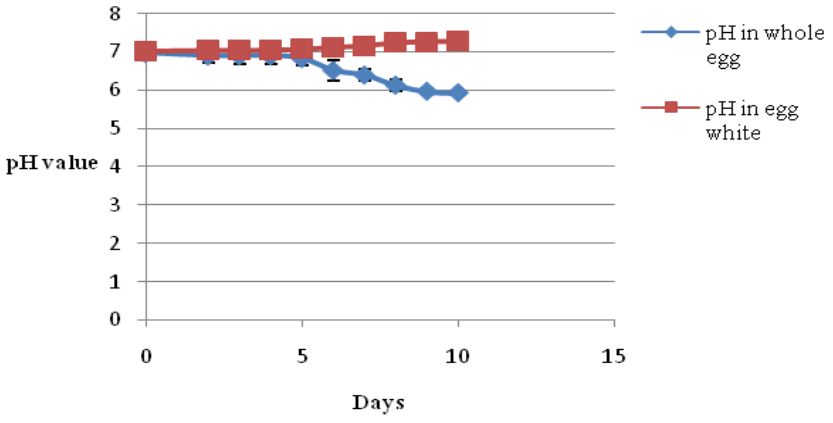

Figure 5: pH change in egg drink during storage at 4°C

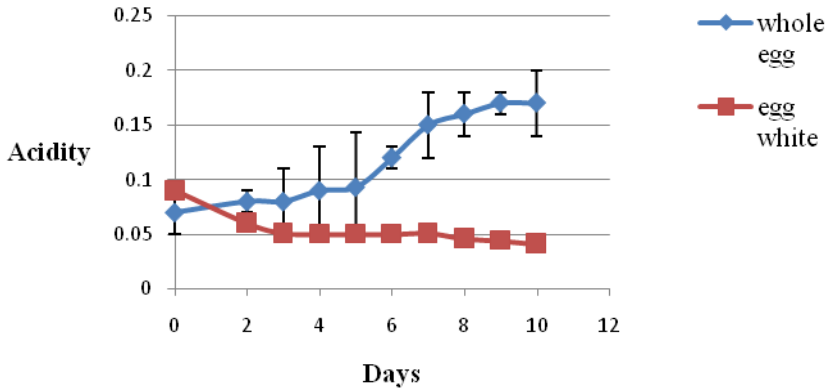

Figure 6: Titratable acidity in selected egg drink products at 4ºC

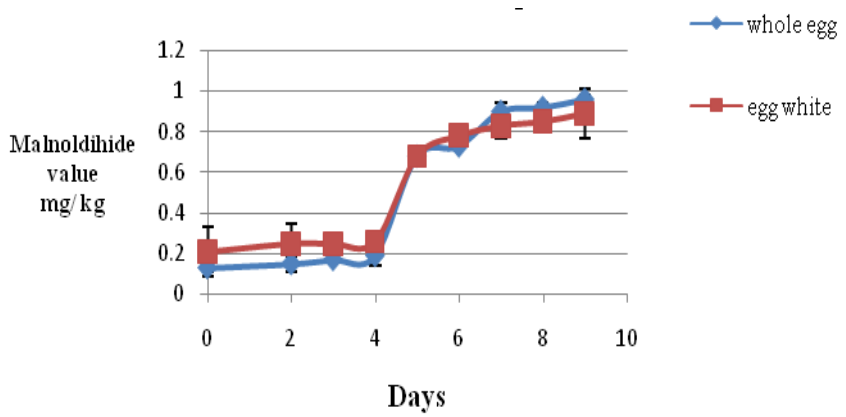

Figure 7: Oxidative change in egg drink during storage at 4ºC

Micro biological result in the product

Microbiological analysis was done for *E. coli*, *Salmonella* and total plate count. *Salmonella* and *Escherichia* were not detected during the storage period of product. But, total plate count has gradually increased with the storage period (10 day). Therefore egg white in cooperated product can be stored under refrigerated condition up to 10 days without any adverse effect while the whole egg incorporated product can be stored up to 05 days.

CONCLUSION

Incorporation of egg into pasteurize liquid drink can increase the protein consumption and can introduce to wide range of age groups. Developed egg based drink can be stored over 5 days under refrigerated condition which contain high amount of protein and cholesterol.

REFERENCES

Abeyrathne E.D.N.S., Lee, H.Y. and Ahn, D.U. 2013. Egg white proteins and their potential use in food processing or and as nutraceutical and pharmaceutical agents- A review. *Poultry Sci.* 92:3292-3299

Addis, P.B. 1986. Occurrence of lipid oxidation products in foods. Food and Chemical Toxicology. 24(10-11):1021-1030.

Agbogidi, O.M. and Azagbaekwe, O.P. 2013. Health and nutritional benefits of nutmeg (*Myristica fragrans* Houtt).

Uniqe Research journal of Agricultural Science. 1(5). 80-84

Campbell, B., Kreider, R.B., Ziegenfuss, T., Bounty, P.L., Roberts, M., Burke, D., Landis, J., Lopez, H. and Antonio, J. 2007. International society of Sports Nutrition position and stand: protein and exercise. *Journal of the International Society of Sports Nutrition*. 4: 1-7

Froning, G.W. 1998. Recent Advances in Egg Products Research and Development. Conference paper presented at the university of California Egg Processing Workshop 2-3, 1998

Haug, A., Hostmark, A.T. and Harstad, O. 2007. Bovine milk in human nutrition- a review. Lipids in Health and Diseases. 6:25. 1-25

Halliwell, B. and Chirico, S. 1993. Lipid peroxidation: Its mechanism, measurement and significance. *American journal of Clinical Nutrition*. 57(5):7155-7245

Huopalahti, R., Fandino, R. L., Anton, M., and Schade, R. 2007. Bioactive Egg Compounds. Springer, NY. P: 3-66

International egg commission,2014, https://www.international egg.com

Lee, H. Y., Abeyrathne, E.D.N.S. and Ahn, D.U. 2014. Sequential separation of IgY and Pjosvitin from egg yolk. *Poultry Sci*.93(10):2668-2677

Mine, Y. 2008 (ed). Egg Bioscience and Biotechnology. John Wiley and Sons. N.J.

Perry, A., Rasmussen, H. and Johnson, E.J. 2009. Xanthophyll (lutein, zeaxanthin) content in fruits, vegetables and corn and egg products. *Journal of food Composition and Analysis*. 22:9-15

SLSI, 1992, Specification for chicken eggs SLS 959:1992.Colombo: Sri Lanka standard institute.

Sim, J.S. and Sunwoo, H.H. 2006 (ed). The Amazing Egg. University of Alberta, Canada

Stadelman, W. J. and Cotterill, O. J. 2001. Egg Science and Technology. 4th ed. Avi. Publ. Co., Westport CT.