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Occupational Health and Safety Considerations in the Nutritional Processing of Red Rice and Atchaya Ponni Rice: A Comparative Study

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Abstract

Nutritionally, red rice is distinguished by its higher antioxidant content, thanks to the anthocyanins in its husk, which offer anti-inflammatory and cardioprotective benefits. Atchaya Ponni rice, on the other hand, is considered beneficial for managing blood sugar levels due to its low glycemic index, making it ideal for individuals with diabetes or those seeking to maintain stable blood sugar levels. However, the processing of these rice varieties must be optimized to retain these nutritional benefits, while also adhering to occupational safety standards to minimize any health risks associated with the production process.This comparative study examines both the nutritional composition of red rice and Atchaya Ponni rice, focusing on the occupational health and safety implications throughout their processing stages.

The interior of both red and white rice's is the same colour: white. Compared to white rice, red rice has a content of zinc and iron that is two to three times higher. Atchaya ponni and Red rice were the rice varieties used for the proximate analysis. Compared to atchaya ponni rice, red rice was shown to have higher fibre content. In comparison to red rice, atchaya ponni has the highest protein content. In comparison to Atchaya Ponni rice, red rice has higher levels of moisture, fat, and ash. Red rice was shown to have higher nutritional content levels.

Key words: Nutrient content-comparison-Red rice-Atchaya ponni rice.

1.INTRODUCTION

Rice is one of the most important staple foods globally, providing essential nutrients and energy for billions of people. Among the many varieties of rice cultivated, red rice and Atchaya Ponni rice stand out for their unique nutritional profiles, offering specific health benefits that cater to different dietary needs. Red rice, known for its rich anthocyanin content and high dietary fiber, is increasingly recognized for its antioxidant properties and health benefits, including its potential role in reducing the risk of chronic diseases such as

heart disease and diabetes. On the other hand, Atchaya Ponni rice, a prominent variety in South India, is prized for its low glycemic index, making it suitable for individuals with diabetes and those aiming to maintain stable blood sugar levels. These rice varieties not only provide essential nutrients but also offer functional properties that contribute to a balanced and healthy diet.

While the nutritional benefits of red rice and Atchaya Ponni rice are well-documented, less attention has been given to the occupational health and safety (OHS) aspects of their production. The processing of rice involves several stages, including harvesting, milling, and packaging, which can expose workers to a range of health hazards. For example, prolonged exposure to rice dust during milling operations can lead to respiratory issues, while repetitive tasks and long working hours may result in musculoskeletal injuries. Furthermore, the use of heavy machinery and manual labor in rice processing facilities can increase the risk of accidents and injuries. Therefore, ensuring that proper occupational health and safety measures are in place is essential to protect workers while maintaining the integrity and quality of the rice.

This study seeks to explore the intersection of nutrition and occupational health and safety in the processing of red rice and Atchaya Ponni rice. It aims to provide a comprehensive comparative analysis of their nutritional compositions, including their antioxidant content, fiber, and glycemic properties, while simultaneously addressing the importance of implementing stringent safety protocols during their production. The health benefits of these rice varieties are only fully realized if the processing environment is safe and the workers involved are protected from potential hazards. By examining both the nutritional properties of these rice types and the occupational health risks associated with their production, this study highlights the need for an integrated approach that ensures both the safety of workers and the high nutritional quality of the end product.

2. MATERIALS AND METHODS

Red rice was purchased from the Shathi store and Archaya Ponni Rice was purchased from Tamil Nadu food grains marketing yard, (Tamil Nadu, Madurai). The research was carried out in the laboratory of Tamil Nadu food grains marketing yard, (Tamil Nadu, Madurai) in the Madurai district.

2.1. Sample Preparation

Grains were milled into powder with using laboratory blender mixer grinder.

2.2. Moisture content

The IS methods, (IS 1155-1968) was used to analyze the moisture content by using hot air oven. The empty dish was heated to 130^{o} C for 10 minutes, after which it was placed in the desiccator. The sample rice was then placed in a dish and dried in an oven set to 130^{o}C for around 5 grams. The sample was then transferred for cooling into a desiccator. Following that, moisture content was determined as follows:

$$\text{Moisture \% (w/w)} = \frac{W1-W2 \times 100}{W}$$

W- Weight of the sample taken (g)

W_1 – weight of empty dish+ weight of the sample before drying (g)

W_2 – Weight of the empty dish+ sample after drying (g)

2.3. Total Ash Content

According to IS Methods, (IS 1155-1968) the Total ash level of red rice flour that was examined by using muffle furnace apparatus. The sample must first be dried out before the ash content of a high moisture product can be determined. First, 5 grams of the sample were placed within a silica crucible. The sample was dried after being placed in a high-temperature muffle furnace for two hours at a temperature of between 550 to 600 °C. This equation can be used to calculate the ash content

$$\text{Total Ash (on dry basis) \% (w/w)} = \frac{W2-W1 \times 100}{W} * \frac{(100)}{(100-M)}$$

W- Weight of the sample taken (g)

W_1 – Weight of the empty crucible before igniting (g)

W_2 - Weight of the test portion after igniting (g)

2.4. Acid Insoluble Ash

According to IS Methods, (IS1155-1968) the Insoluble ash level of red rice flour that was examined by using muffle furnace apparatus. The sample must first be dried out before the ash content of a high moisture product can be determined. First, 5 grams of the sample were placed within a silica crucible. The sample was dried after being placed in a high-temperature muffle furnace for two hours at a temperature of between 550 to 600 °C. The sample was then transferred for cooling into a desiccator. Then add 25ml of dilute HCL heat on a water bath for 10 mines, using whatmen filter paper No.42. The sample was dried after being placed in a high-temperature muffle furnace for two hours at a temperature of between 550 to 600 °C. This equation can be used to calculate the ash content

$$\text{Acid Insoluble Ash (on dry basis) \% (w/w)} = \frac{W2-W1 \times 100}{W} * \frac{(100)}{(100-M)}$$

W – Weight of sample taken (g)

W_1 - Weight of empty crucible before igniting (g)

W_2 – weight of the test portion after igniting (g)

M – Moisture content of sample

2.5. Fat Content Analysis

According to SI Methods, (IS 4684 – 1975) the fat content level of red rice flour that was examined by using socs plus apparatus. Weigh 5 grams sample in coarse filter paper, fold, keep it in thimble and extract with the petroleum ether extraction apparatus for 5 hr. after completion of extraction remove the thimble and recover the solvent. Dry the beaker along with the fat on hot air oven at 95-130°c for 2 hr. fat content was determined following the calculation:

$$\text{Fat \% (w/w) dry basis} = \frac{W2-W1 \times 100}{W} * \frac{(100)}{(100-M)}$$

W- Weight of sample taken for the test, g

W1- Weight of the sample soxhlet flask clean & dry

W2- Weight in g of the soxhlet flask/ beaker with the extracted fat

2.6. Crude Fiber Analysis

According to SI Methods, (IS 1155 =1968) the crude fiber content level of red rice flour that was examined by using hot air oven apparatus. Weight 2 grams fat removed sample 200 ml of water and add sulphuric acid then by using hot plate for 45 min. next residue was collected in beaker and taking 2.5 gram of NaOH added and boil exactly 45 min. take a what men filtrate paper into filter residue. Keep it in a hot air oven maintained at 132°c for 1hr. crude fiber content was determined following the calculation:

$$\text{Crude Fiber (CF) \%} = \frac{W2 - W1 \times 100}{W} * \frac{100}{100 - M}$$

$$\text{Crude Fiber \% on dry basis} = CF * \frac{100}{100-M}$$

W – Weight of sample taken for the test (g)

W_1 – Weight of empty Gooch crucible clean & Dry

W_2 – Weight in g of the Gooch crucible after dry

M – Moisture content of sample

2.7. Protein analysis

According to FSSAI MANUAL 2016 Methods, (Cereal & cereals Product) the protein content level of red rice flour that was examined by using kel Plus (Digestion and Distillation) apparatus. In a 250 ml digestion flask, place 0.25 grams of sample, 0.5 grams of copper sulphate, 2.5 grams of potassium sulphate, and 10 ml of concentrated sulfuric acid. Pre-heat the digestion unit to 350 ° C. For two hours, digest the sample at 420°C. It will take about 30 minutes to cool. Take a digested sample and then use it in the kel plus distillation process by loading the sample tube on the sample side. During the process, add 40 ml of the 40% alkali; liquid ammonia will accumulate in the boric acid and the color of the boric acid will alter depending on the indicator employed. Utilize methyl red indicator for titrating against 0.1 N Hcl standards. The end is a pale pink color.

$$\text{Nitrogen (N) \% Wet basis} = \frac{14.01*\text{Strength of Titrant (0.1N)}*(TV-BV)*100}{W*1000}$$

Protein content (%) =%N x C

TV – Titre Value

BV – Blank Value

W – Weight of sample

C – Conversion factor – For cereals

C= 5.7, Pules=6.25

2.8. Carbohydrate Analysis

Using the formula, total carbohydrates are estimated from the determined percentages of moisture, protein, fat, & total ash.

Carbohydrate (%) = 100-(A+B+C+D+)

A- Percentage of Moisture

B- Percentage of Protein

C- Percentage of Fat

D- Percentage of Total ash

2.9. Energy analysis

According to SI Methods, (IS 14433 -2007) the Energy is computed by adding the sample's measured proportions of protein, fat, and carbohydrates to the appropriate factor.

Energy Kcal/100g = 9x Fat content + 4x Protein + 4x carbohydrate

2.10. Statistical analysis

All analytical determinations were carried out in triplicate and mean values with standard deviation (SD) are presented P values <0.05 were considered as statistically significant.

3. RESULTS AND DISCUSSION

The nutritional composition of Red rice and Atchaya ponni rice was given in Table 1. And Figure 1 and 2. Fibre content of red rice revealed that 3.8±0.17 g/100g and atchaya ponni rice had 0.3±0.01 g/100g. Raghuvanshi *et al.* (2017) found that the moisture content of red rice 12.75%, protein 10.49%, 1.53% of ash, 1.815% of fat 2.7% of fibre and 70.19% of carbohydrate. Petroni *et al*. (2017) reported that the moisture, 10.77%, carbohydrate 71.20%, protein 7.88%, lipid 4.32% ash 1.42% and dietary fibre 4.40%. The findings show that red rice has the highest concentration that can give samples a longer shelf life, reduced microbial contamination, and the preservation of some nutrients. As a good source of energy, carbohydrate, and crude fibre, red rice is produced.

Table 1. Nutritional composition of Red Rice and Atchaya Ponni Rice

S.No	Nutrients	Samples	
		Atchaya ponni rice	Red Rice
1.	Moisture %	9.8±0.2	11.81±0.3
2.	Protein g%	9.8±0.2	9.5±0.2
3.	Fat g%	0.5±0.01	2.7±0.08
4.	Crude Fiber g%	0.3±0.01	3.8±0.17
5.	Total Ash g%	0.52±0.01	1.72±0.03
6.	Acid Insoluble Ash g%	0.05±0.001	0.15±0.006
7.	Carbohydrate g%	79.38±2.8	74.27±2.6
8.	Energy g%	361.22±10.8	359.38±10.7

All data are the Mean ± S.D of three replicates

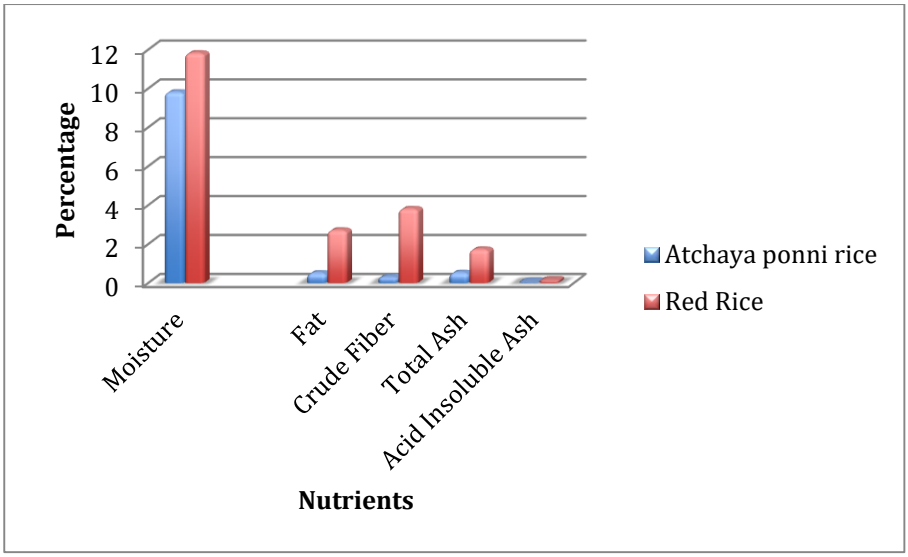

Figure 1.Nutritional compostion of Red rice and Atchaya ponni rice

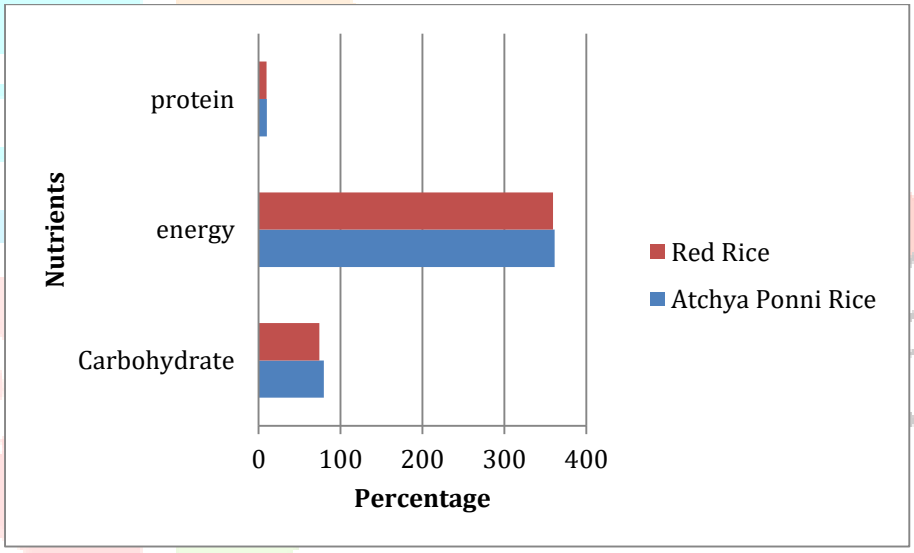

Figure 2. Protein, energy and carbohydrate content of Red Rice and Atchaya ponni rice

4. CONCLUSION

The investigation concluded that red rice contained good sources of insoluble ash, total ash, and carbohydrate, high crude fiber content of red rice suitable for constipation and diabetes patients. Hence various innovative products may be developed to suit the consumer needs and also to achieve nutrition security. Rice is devoid of gluten. Because rice is completely gluten-free, it is the best option for persons who must adhere to a gluten-free diet. In addition, there are advantages for your skin as well as protection against heart disease, dysentery, and high blood pressure. The study revealed that red rice has the potential to be used in new food formulations and can be regarded as a diet that is safe for human consumption. Both red rice and Atchaya Ponni rice offer significant nutritional benefits, contributing to improved health outcomes, such as enhanced antioxidant intake, better blood sugar management, and overall dietary balance. Red rice, with its higher anthocyanin content, provides notable antioxidant properties that can help

mitigate the effects of oxidative stress, while Atchaya Ponni rice, with its low glycemic index, serves as a valuable option for individuals managing diabetes or those seeking to stabilize their blood sugar levels. The nutritional advantages of these rice varieties are clear, but their benefits can only be fully realized if the production and processing stages are conducted with proper attention to occupational health and safety (OHS) standards.

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