

Effect of Processing on Reduction of Pesticides Residues in Long Grain Rice

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INTRODUCTION

In order to improve the quality of agricultural products during cultivation and storage, pesticides are crucial in preventing and controlling diseases and pests (1). However, the negative effects of pesticides on the environment and human health continue to be a significant issue. Pesticide application can result in both acute and chronic human toxicities (2). For a sizable section of the world's population, rice serves as staple food and main source of nutrients (3). Due to this, there is rising interest in the establishment of analytical techniques that allow to identify pesticide residues in rice-based food and feed samples at low detection limits.

METHODOLOGY

In the present study, different processing methods were tested in order to evaluate the effects of washing, washing with vinegar (5%, v/v), cooking (traditional method), steam cooking and their combination on reduction of 121 pesticides residues in long grain contaminated rice samples. The samples were extracted by Quick, Easy, Cheap, Effective, Rugged, and Safe (QuEChERS) Method followed by High Performance Liquid Chromatography tandem mass spectrometry (HPLC-MS/MS).

Sample preparation for processing

- Before the cooking process, one solution with a concentration of 50 µg/kg was prepared for the contamination of the long rice in a beaker with water (Figure 1).

Washing

- In washing with mineral water, a 20 g portion of the rice samples was washed and soaked in 100 mL of this water for 20 minutes. The samples were grounded and then analyzed.
- In washing with vinegar, a 20 g portion of the rice samples was washed with mineral water and soaked in 95 mL of this water and 5 mL of vinegar for 20 minutes. The samples were grounded and then analyzed.

Cooking

- For each sample, a mixture of 20 g of the rice sample, and 40 mL of water was placed in a beaker. The mixture was boiled on a stove until the water evaporated, approximately 10 minutes (Figure 1). Then, the cooked rice sample was completely crushed and analyzed.

Steam Cooking

- For each sample, a mixture of 20 g of the rice sample was placed in a small round stainless-steel sieve with a fine wire mesh (Figure 1). Then, the rice was cooked with steam cooking from a beaker with 500 ml of boiling water. Each sample took approximately 1 hour to cook. Then, the cooked rice sample was completely crushed and analyzed.

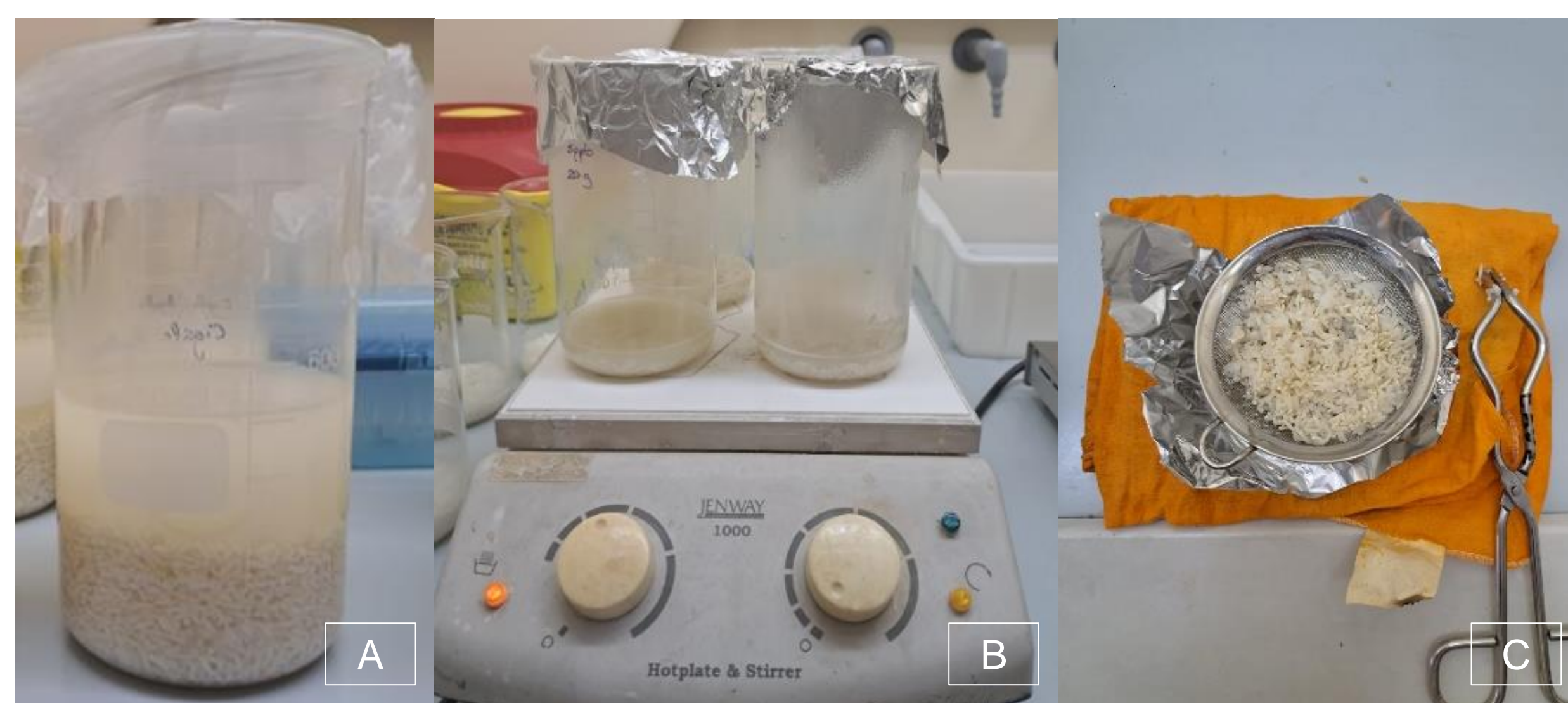


Figure 1. A- Contamination of long grain rice with a solution of pesticides at a level of 50 µg/kg. B- Cooking process of the contaminated long grain rice samples. C- Small round stainless-steel sieve with a fine wire mesh with cooked rice.

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RESULTS

Unprocessed Samples

To calculate the pesticide reduction throughout the washing and cooking processes, it is important to ascertain the pesticide concentration in unprocessed rice samples. The mean concentration of the studied pesticides was in the range of 11.27- 41.73 µg/kg.

Effects of Washing and Washing with Vinegar

The percentage reduction after washing ranged from 0.21 to 73%. More than 40% of the pesticides presented a reduction between 40-60% and more than 10% of pesticides presented a reduction higher than 60% just after washing with mineral water (Figure 2).

The percentage reduction after washing with vinegar (5%, v/v) varies from 26.8 to 80.3%.

Figure 2 shows that there is a higher percentage of pesticides, with a 60% reduction of pesticides contamination when washing with vinegar (5%, v/v) compared to washing with just mineral water.

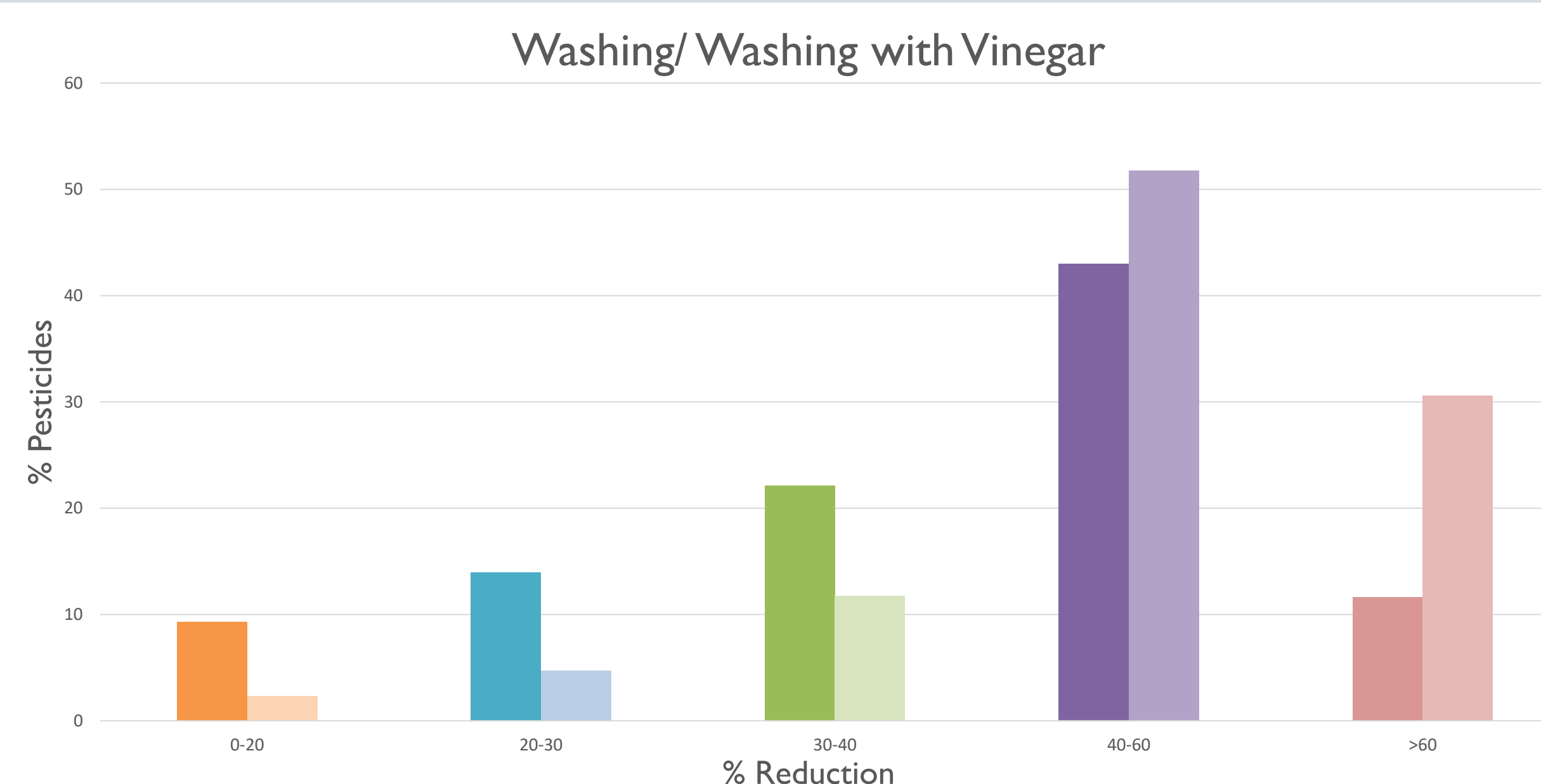


Figure 2. Comparison of the effect of washing with vinegar (5%, v/v) and washing just with water in the reduction of the initial concentration of pesticides in contaminated rice samples.

Effects of Cooking

In cooking, more than 35% of pesticides reduce between 50 and 60%, and about 15% of pesticides reduce more than 70%.

In steam cooking, about 30% of the pesticides achieved a reduction of 60 to 70%, and approximately 25% of the pesticides had a reduction higher than 70%.

In washing and cooking, 45% of pesticides achieved a reduction between 60 and 70%, and 10% of pesticides achieved a reduction above 70%.

Also, the combination of washing with vinegar and traditional cooking allowed to obtain the highest percentage of pesticides (35%) with a reduction higher than 70% (Figure 3).

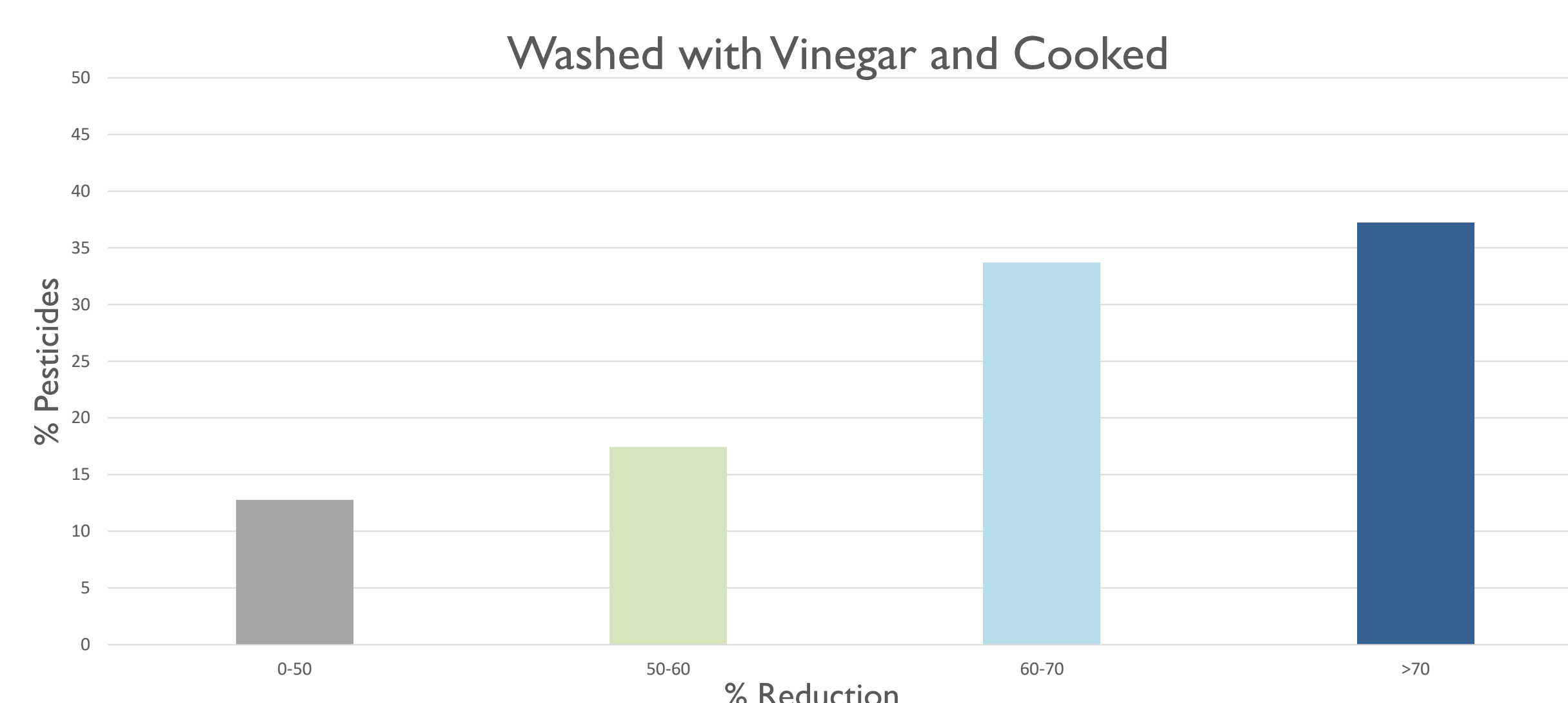


Figure 3. Effect of combination of washing with vinegar and conventional cooking on the pesticides' reduction in contaminated rice samples.

CONCLUSIONS

- This study demonstrated that it is possible to considerably reduce pesticides by washing and cooking, and the level of reduction depends on the molecule.
- The removal of pesticide residues due to processing is affected by the degree of adsorption of pesticides by the cereals' grains, pesticide residues' solubility in water and heat-induced breakdown. The rice samples submitted to both processing methods (wash with vinegar and cooking) presented higher reduction factors.
- In this line, it is recommended to use, at domestic and industrial levels, both methods in order to better guarantee food safety.