

PERFORMANCE OF DIFFERENT TYPES OF MIXERS FOR MIXING FORTIFIED RICE

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ABSTRACT

Rice is the dominant staple food crop of approximately half of the population worldwide. Micronutrient deficiencies of public health significance are all widespread in most high rice consuming countries. The fortification has the potential to help aid vulnerable populations. Rice can be fortified by simply adding a micronutrient powder to the rice that adheres to the grains or spraying of the surface of ordinary rice grains in several layers with a vitamin and mineral mix to form a protective coating. Blending fortified rice with normal rice requires mixers. Performance of few types of mixers available in the market was evaluated for mixing fortified rice. Mixing index of the different blenders such as concrete blender, ribbon blender and fluidized bed mixer were used for the blending efficiencies. A drum blender was also fabricated and its blending efficiency was evaluated. Normal rice and fortified rice in the ratio 100:1 were taken and used in the experiments for determining the mixing index using ribbon blender, fluidized bed mixer, concrete blender and drum blender. Among the four types of mixers used, fluidized bed mixer gave the maximum mixing index of 0.99. The maximum mixing index obtained with drum blender was 0.998 when it was inclined at an angle of 14° with the horizontal. Concrete mixers and drum blenders can be used for blending normal rice with fortified rice in the ratio of 100:1 for large scale processors. For small scale processors, fluidized bed blenders can be used for blending.

Keywords: Mixing index, Drum blender, Fluidized bed mixer and fortified rice

1. INTRODUCTION

Rice is the dominant staple food crop of approximately half of the population worldwide. Micronutrient deficiencies of public health significance are all widespread in most high rice consuming countries. The rice fortification has the potential to help aid vulnerable populations. Rice can be fortified by simply adding a micronutrient powder to the rice that adheres to the grains or spraying of the surface of ordinary rice grains in several layers with a vitamin and mineral mix to form a protective coating (WHO, 2013). Vitamin and mineral deficiencies are important public health concerns worldwide. Among the options to address these deficiencies, mass fortification represents an appealing intervention as it takes advantage of the existing market and delivery systems, does not require the active participation of vulnerable populations to increase foods intake or diversify the diet, and has few safety concerns. Rice represents a suitable vehicle for fortification as it is considered a staple food in most of the world, especially in regions where micronutrient deficiencies are most evident.

2. MATERIALS AND METHODS**2.1 Rice**

Adt 43 rice variety was used in the experiments to determine the mixing index of fortified rice with normal rice. The rice was purchased from the local market.

2.2 Fortified rice

Fortified rice is made of natural rice. Broken rice kernels were used as raw material. It is obtained

from a supplier who manufactures fortified rice from the broken rice.

2.3. Blenders

Four blenders namely concrete blender, fluidized blender, ribbon blender and drum blender were selected for the study (Fig. 1 to 4)



Fig.1 Concrete blender



Fig.2 Fluidized bed mixer



Fig.3 Ribbon blender



Fig.4 Drum blender

Normal rice (1 kg) and fortified rice (10g) in the ratio 100:1 were used in the experiments for determination of mixing index of the ribbon blender, drum blender and fluidized bed mixer, whereas 3 kg of normal rice and 30g of fortified rice were taken(100:1) in concrete blender.

2.4 Independent variables

2.4.1 *Types of blenders* - Concrete blender, fluidized blender, ribbon blender, drum blender

2.4.2 *Mixing Time*

1. 15, 20, 25, min for concrete mixer
2. 5, 10, 15 min for fluidized bed mixer
3. 10, 15, 20 min for ribbon blender,
4. Slope in drum blender - 6, 7, 8, 11, 12, 13, 14°

2.5 Dependent variable

2.5.1 *Mixing index*

Known quantity of normal rice and fortified rice were fed in the blenders and operated for the specified time. The blended rice was spread in a tray then samples (approximately 10 g each) were taken randomly at ten places in the tray. The raw rice and fortified rice were separated by hand picking, counted and weighed separately. Mixing index was calculated based on the formula. The experiments were repeated 3 times.

$$(M) = \frac{(S_o^2 - S^2)}{(S_o^2 - S_r^2)} \quad (1)$$

Here,

$$S_o^2 = p(1-p) \quad (2)$$

p= Fractional weight of Raw rice

(1-p)= Fractional weight of fortified ice

$$S^2 = \frac{1}{n} (\sum(X_i^2)) - (\bar{x})^2 \quad (3)$$

$X_i = (p)$ fractional weight of normal rice

\bar{x} = mean value

$$S_r^2 = \frac{S_o^2}{N} \quad (4)$$

N= No. of total rice

3. RESULTS AND DISCUSSION

3.1 Mixing Index

Mixing index of the different blenders namely, fluidized bed mixer, concrete mixer and ribbon blender, and drum blender was determined and the results are tabulated in Table 1 & 2.

Table 1. Mixing index of blenders

Blender	Time (min)	Wt of raw rice (kg)	Wt of Ultra rice (g)	Mixing Index
Fluidized bed	5	1	10	0.9211
	10	1	10	0.9962
	15	1	10	0.9437
Concrete mixer	15	3	30	0.9342
	20	3	30	0.9447
	25	3	30	0.9858
Ribbon blender	10	1	10	0.9342
	15	1	10	0.9732
	20	1	10	0.9273

Table 2. Mixing Index and Discharge time in Drum blender

S.No	Slope, °	Discharge time, sec	Mixing index
1	6	480	0.9236
2	7	240	0.9315
3	8	180	0.9436
4	11	60	0.9529
5	12	49	0.9611
6	13	39	0.9779
7	14	34	0.9985

4. CONCLUSION

Normal rice (1 kg) and fortified rice (10g) in the ratio 100:1 were used in the experiments for determination of mixing index using concrete blender, fluidized bed mixer, ribbon blender, and

drum blender. Among the four types of mixers used, fluidized bed mixer gave the maximum mixing Index as 0.99. In Drum blender mixing index was maximum as 0.998 when it was inclined at an angle of 14° with the horizontal.

Based on the results, it was found that the mixing indices were above 0.9 for all the types of blenders. However, observing the mixing indices approaching close to 1.00, it is recommended that concrete mixers and drum blenders can be used for blending fortified rice with normal rice in the ratio of 1:100 for large scale processors. For small scale processors, fluidized bed blenders can be used for blending.

5. REFERENCES

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