# ASSESSMENT OF THE PRODUCTION AND DETERIORATION OF IRON-RICE PREMIX FROM DIFFERENT LOCAL MANUFACTURERS THROUGH STATISTICAL PROCESS CONTROL TOOLS

DOST-FNRI
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## INTRODUCTION

The Department of Science and Technology-Food and Nutrition Research Institute (DOST-FNRI) developed and scaled up the production of iron-rice premix (IRP) in compliance with the Philippine mandatory fortification through rigorous product development, small- and large-scale modeling projects. To date, the technology has been licensed to eight local manufacturers. To ensure product quality, a Statistical Process Control (SPC) must be conducted to provide a systematic and data-driven framework for identifying variation in the manufacturing process. This study aims to characterize IRP from manufacturers and evaluate its quality characteristics using SPC to account for variations in extruder equipment and production environments, thus ensuring quality and consumer acceptance.

### Specifications

- 300-500 mg Fe/100 g
- ≤ 13% moisture content
- ≥85% whole kernels & ≤15% off-shaped
- No rancid-like odor
- Contaminants: ≤0.2 mg/kg As and Pb, ≤0.4 mg/kg Cd, ≤10 pbb aflatoxin level
- 3-4 log CFU /g for yeast & mold count

Figure 1. IRP specifications

### Fortification efforts

IRP is developed using extrusion technology to combat anemia in the Philippines.

## METHODS

01 Sampling of IRP from four local producers based on criteria decision analysis and Codex CAC/GL 50-2004 [1]. Coded as M1, M2, M3 & M4.

02 Characterization of IRP: Kernel composition & dimension, bulk density, color, moisture, iron content (AOAC 999.10), and sensory evaluation.

03 Assessment of IRP production via SPC tools: control charts, use of in-control data & deterioration assessment via sensory rating (n=3), iron content (n=2), & microbiological (n=2).

## RESULTS & DISCUSSION

**PHYSICO-CHEMICAL.** Variability in the dimensions of kernels was due to differences in the mold size of the extruder machines. Still, all producers were compliant with kernel dimensions for whole and off-shaped kernels, moisture content, except for M4 (Fig. 2), iron content (Fig. 3), and color profile of light yellow hue (87.7 ± 0.02 to 92.8 ± 0.09).

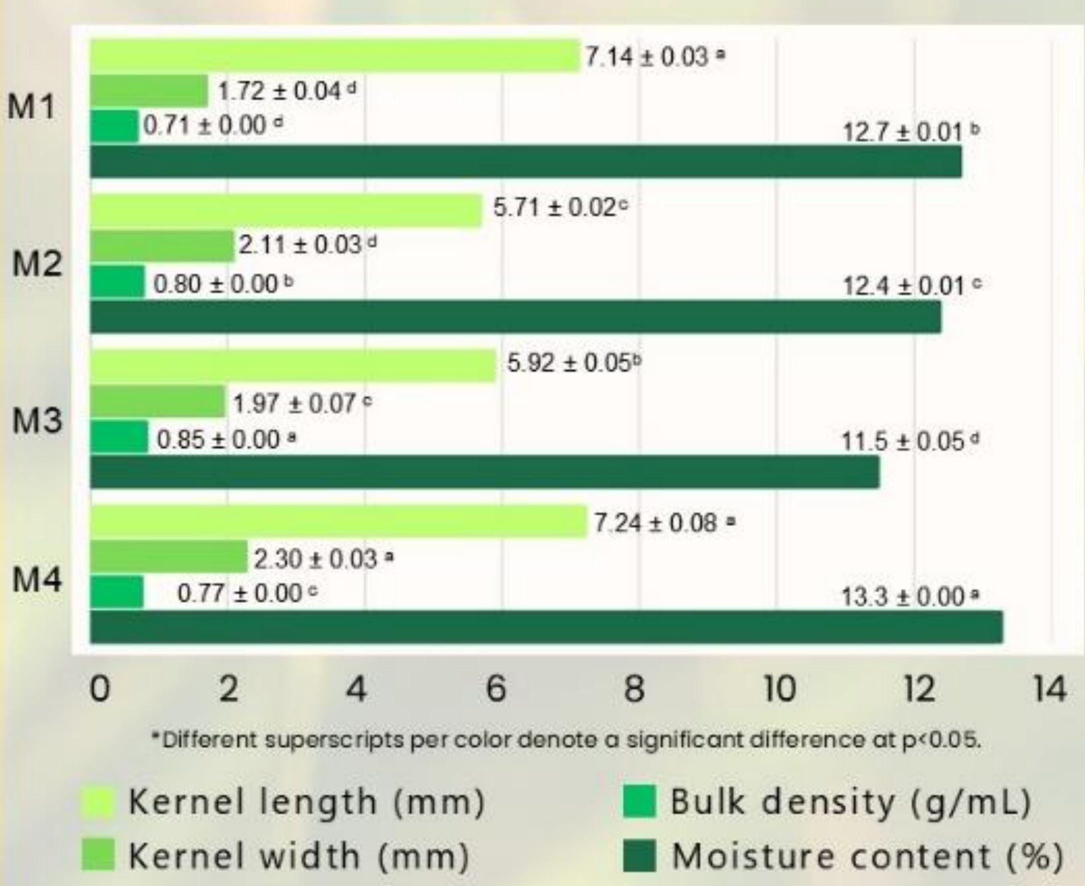



Figure 2. Physico-chemical attributes

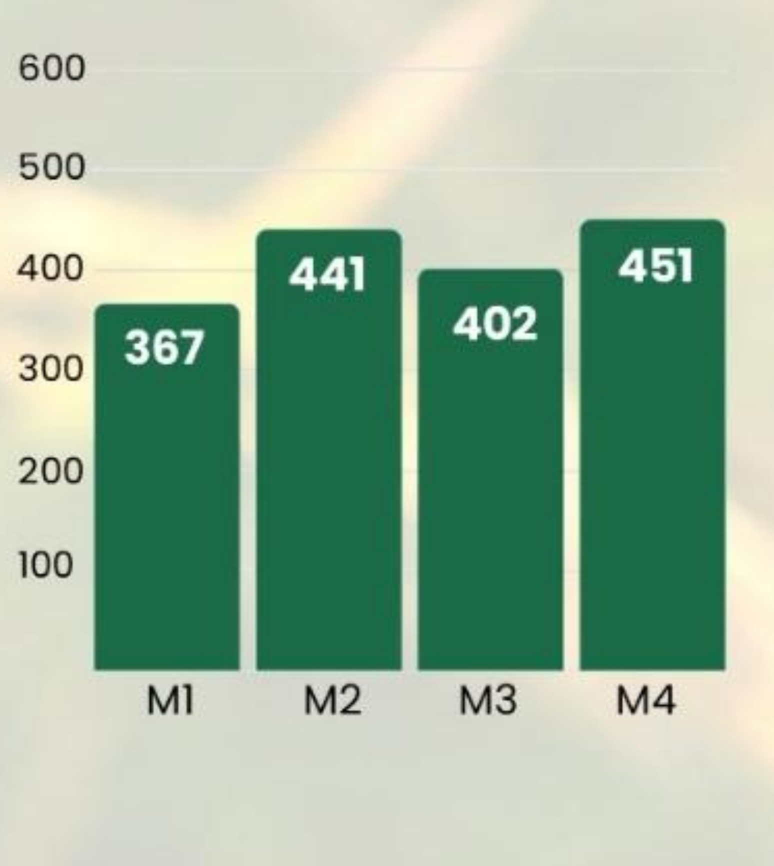



Figure 3. Iron content (mg/100g)

**SENSORY EVALUATION.** No rancid odors, flavors, or aftertaste were detected in the consumer test. The cooked iron-fortified rice (IFR) scored 7.40 to 7.50, meaning panelists "liked it very much".

**SAFETY.** The yeast and mold count (YMC) was below 3 log CFU/g, heavy metal content and aflatoxin were within safe limits (<0.05 ppm Cadmium, <0.15 ppm Lead, <0.005 ppm Arsenic, ≤10 ppb aflatoxin), indicating product is fit for human consumption.

**ASSESSMENT OF QUALITY USING SPC.** Figure 4a showed that two out of the four manufacturers were statistically controlled and capable of producing conforming units ($p<0.15$, $C_{p-KD}>1.33$). Figure 4b showed M1 and M2 $\hat{p}$ for kernel composition meeting the Upper Specification Limit (USL), demonstrating high production capability.

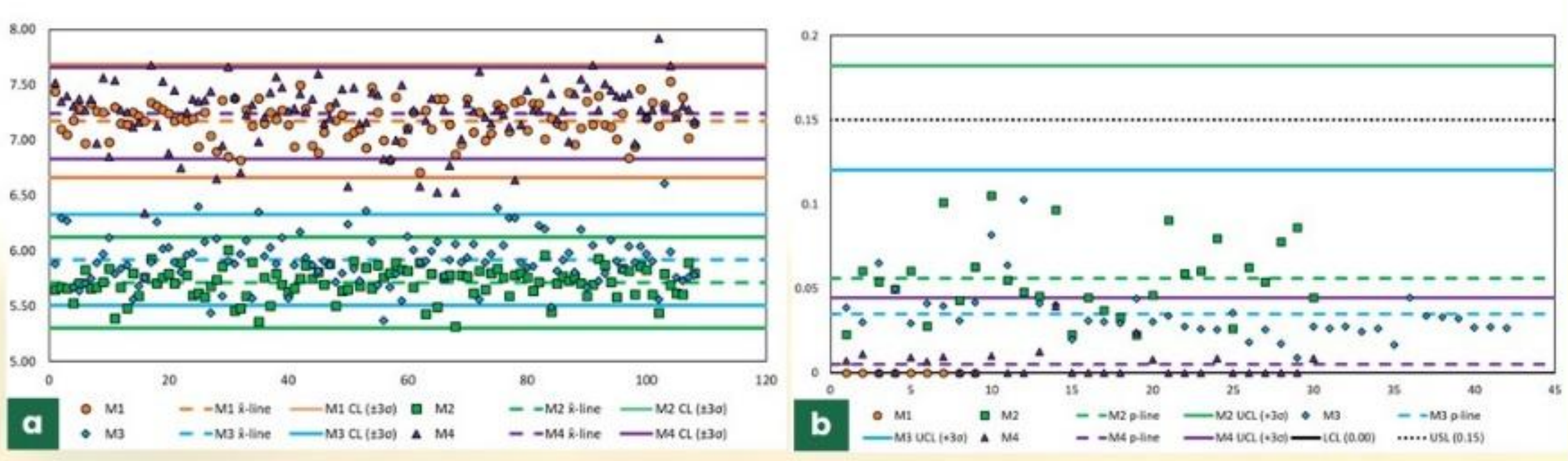
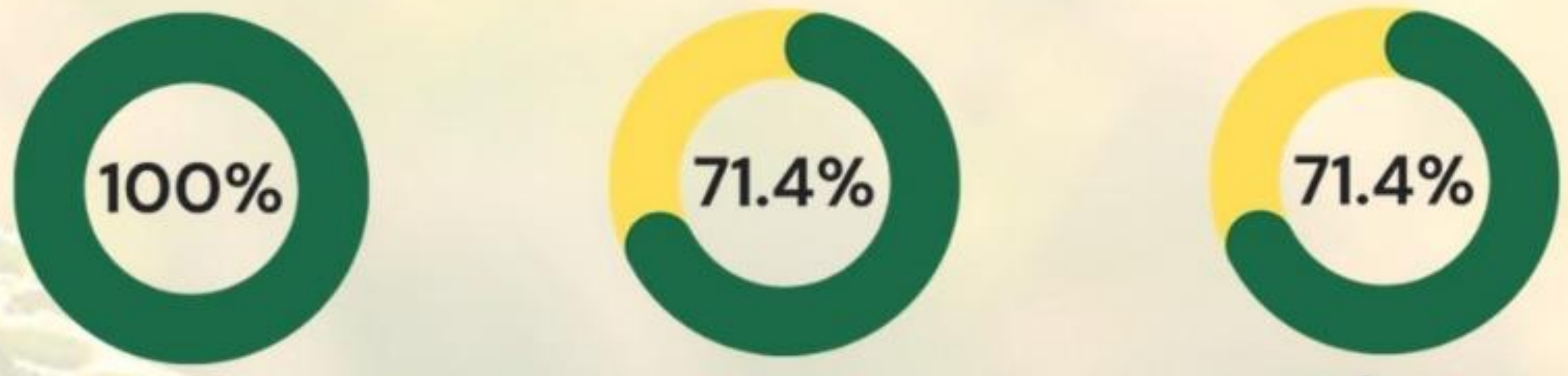



Figure 4 . Control charts for kernel composition (a) $\bar{x}$ and b) $\hat{p}$

### CONFORMITY METRICS OF CONTROLLED PROCESSES




**Manufacturers 1 & 2**
All 7 parameters complied with the FDA Circular No. 2007-010A [2]

**Manufacturer 3**
kernel length and width were out of control

**Manufacturer 4**
kernel length and moisture were out of control

**DETERIORATION ASSESSMENT.** There were no significant differences (p> 0.05) in the hedonic rating of cooked IFR and iron content during storage for six months. After six months, YMC was 3.41 log CFU/g, exceeding the maximum microbial load achievable following Good Manufacturing Practices, but not the control limit for sample rejection.

## CONCLUSION & FUTURE WORKS

The IRP remained stable in terms of physico-chemical, iron content, and sensory qualities when stored at ambient temperature, supporting its commercial potential and reliable replication of the DOST-FNRI technology with effective in-process control. Manufacturers should target supply chain improvements to resolve vulnerabilities and maintain statistical control. The study recommends manufactures to use SPC for IRP quality monitoring. Future works include the training IRP licencees in using SPC, further product innovations including multi-nutrient rice kernels (MNERK), and technology transfer of MNERK to existing IRP manufacturers.

REFERENCES
1 [CAC] CODEX ALIMENTARIUS COMMISSION. 2004. Codex General Guidelines on Sampling, CAC/GL 50-2004. Codex Alimentarius Commission, Food and Agriculture Organization of the United Nations-World Health Organization. Retrieved from https://www.fao.org/uploads/media/Codex_2004_sampling_CAC_GL_50.pdf on 14 Mar 2025.
2 [DOH-FDA] DEPARTMENT OF HEALTH - FOOD AND DRUG ADMINISTRATION. 2007. Updated Standards for Iron-Rice Premix Amending Bureau Circular No. 2007-010 entitled "Guidelines in the Initial Issuance and Renewal of License To Operate for Iron Rice Premix Manufacturer/Repacker/Importer and Setting Forth the Standards for Iron Rice Premix", FDA Circular No. 2007-010-A. Food and Drug Administration, Department of Health, Republic of the Philippines. Retrieved from https://www.fda.gov.ph/wp-content/uploads/2021/12/FDA-Circular-nO.-2007-010A.pdf on 07 Mar 2025.