Southeast-Asian J. of Sciences Vol. 5, No. 1 (2017) pp. 84-91

USE OF RICE BIOCHEMICAL PROPERTIES TO PRODUCE GABA & GLUTEN FREE RICE NOODLE IN VIETNAM

Phan Phuoc Hien[*], **Jong Dae Park**[†] and **Pham Minh Quoc**[‡]

[*]*Southern Can Tho University*
& Korea- Vietnam Incubator Park

[†]*Korea Food Research Institute*

[‡]*Korea-Vietnam Incubator Park*

Abstract

Purpose of the research is to find out the best mixture formula among the different Vietnamese rice varieties without WhF in processing gluten free rice noodle, and the conditions suitable for GABA natural fermentation from the different brown rice varieties. Results of the last research showed that biochemical properties of the rice varieties and their mixture formula clearly influenced on quality of the end-product responding to the national standards of Vietnam (TCVN), Namely all the 03 rice varieties experimented BHT, BDST & BHR can be used to process rice noodle with different mixture formula in such a way that the final mixture must reach the amylose content from 20 to 27%. Based on that gluten free rice noodle was produced from the mixture of the different rice varieties without WhF, and met the requests both sensory and physio-chemical standards of Vietnam. Essentially, GABA was also produced with high content (214 mg/kg) in the rice material by aerobic fermentation method in natural condition in Mekong River Delta. Therefore. it can be concluded that the GABA and gluten free rice noodle was successfully produced for the first time in Vietnam

Key words: GABA (γ-Amino Butyric Acid), Gluten free, TCVN (Vietnam national standard), WHT (White Rice Ham Trau), BDST (Brown rice Do Soc Trang), BHR (Brown rice Huyet Rong), WhF (Wheat flour Sensory method), amylose, gel-consistency, lactic fermentation

1. Introduction

Study to improve production technology and quality of Vietnamese rice noodle" is the co-research and technical support for rice processing in Vietnam of The Korea Food Research Institute (KFRI). The project was jointly cooperated and operated by KFRI & KVIP (Vietnam-Korea Incubator Park) with the aim of producing a new rice noodle product from different rice varieties with high nutritional value and good sensory quality to resopond to both domestic and international market.

Based on the first phase research result of the project in 2016, the second phase in 2017 was further implemented in combination with a lot biochemical experiments and analysis to determine biochemical properties of the rice varieties and the best mixture formula among them to be fit for processing new rice noodle products with higher quality, more beautiful colors, better taste and status, essentially with GABA & GLUTEN FREE was successfully produced for the first time from vietnamese rice.

2. Methods and Research Contents

1.1. Materials, chemicals and instruments

- *Materials:*

+ Brown rice: Ham Trau (BHT), Huyet Rong (BHR), Do Soc Trang (BDST),

+ White rice: Ham Trau (WHT), and Wheat Floor (WhF)

- Chemicals: Kali hydroxide, Natri hydroxide, Thymol Blue, Ethanol, Acid Acetic 99,5%, Amylose potato, Iodine, $H_2SO_4, H_3BO_3 \ldots$

- Analysis equipments: UV-VIS, heater, vortex, freezer ...

- Rice noodle production line: Ut Ba Factory, Can Tho city

1.2. Analytical method of quality evaluation

- Sensory evaluation: by TCVN 3251: 1979 (Viet Nam National Standard)

- Physico-chemical properties:

+ Protein: by FAO Method FNP 14/7 p.224 1986, and Phan Phuoc Hien (2009, 2012, 2014)

+ Amylose: by TCVN 5716 - 2: 2008, and Phan Phuoc Hien (2009-2012, 2014)

+ Gel consistency: by TCVN 8369: 2010, and Phan Phuoc Hien (2009, 2012, 2014)

+ GABA (γ-Amino Butyric Acid): by HPLC (K.Rea, T.I.F.H Cremers and B.H.C. Westerinks, 2005)

- *Total Number of Lactic bacteria:* by TCVN 7906: 2008.

1.3. Experimental layout and coded.

- Sample A: 50% WHT + 50% BDST, soaked duration: 24 hours.
- Sample B: 60% WHT+ 40% BDST, soaked: 24 hrs.
- Sample C: 50% WHT + 40% BDST + 10% WhF, soaked"24 hrs.
- Sample D: 60% WHT + 20% BDST + 20% BHR, soaked: 24 hrs.
- Sample E (Control): 100% WHT, Soaked: 24hrs.

3. Results and Discussions

3.1 Quantification of amylose content and gel-consistency of the experimental materials

Prior to processing, all rice varieties and materials were quantitatively analyzed amylose content and gel-consitency. Analysis results are shown in the Tables 1 and Diagram 1 as follows:

Table 1: Amylose content and gel-consistency of the experimented rice varieties & WhF

Experimetal materials	Amylose content (%)	Gel-consistency (mm)
WHT	26.59±1.33	52.33±2.62
BDST	19.20±0.96	86.67±4.33
BHR	15.40±0,.77	90.30±4.52
WhF	12.87±0.64	100.00±5.00

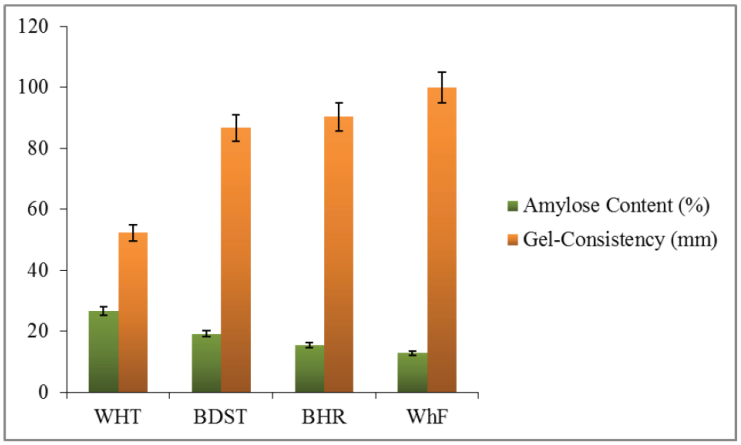

Diagram 1: Amylose content and gel-consistency of the experiental materials

- The analysis results showed that the WHT had the highest amylose content (26.59%), followed by the BDST (19.20%) and the lowest was the BHR

(15.40%). Conversely, the gel-consistency of the WHT is low (52.33: average grade), BDST and BHR had high gel-consistency (> 61 mm: soft grade).

- WhF had a lowest amylose content (12.87%) and highest gel-consistency (¿100 mm), which made change the amylose content as well as the softness of the rice noodle when added in the mixture (Sample C). At the Utba factory, WHT was only used 90% with 10% WhF to produce rice noodle (Treatment Control E: 90% WHT + 10% WhF). Particularly for the tested brown rice noodle, the supplement of BDST and BHR (lower amylose content) made the rice noodles softer and smoother (Sample A, B, C, D).

Figure 1: The colored rice noodle from WHT mixed with BDST and BHR with different shape and size from the last experiment

3.2. Lactic fermentation: After 24 hrs fermentation, all the rice varieties powders were sampled for quantification analysis of total number of lactic bacteria. The results in the table 2 showed that WHT reached the highest total number of lactic bacteria ($2x10^8$ CFU/g), followed by BDST ($1.6x10^8$ CFU/g) and BHR ($1.3x10^8$ CFU/g).

Table 2: Total Number of lactic bateria (CFU/g) of rice flour materials with SD 24 hours

Rice flour with 24 hrs fermented	Total Lactic bacteria (CFU/g)
WHT	2.0×10^8
BDST	1.6×10^8
BHR	1.3×10^8

3.3. Bio-chemical analysis of the end-products: Bio-chemical properties such as amylose content, gel-consistency, total lactic bacteria and protein content of all the end-products were analyzed and evaliuated.The results are presented in the table 3 and 4 as follows

- As shown in the table 3, all the rice noodle samples had a gel-consistency of over 100 mm (soft grade). This showed that the rice noodles were highly flexible, cooked rice starch and gelatinization so that gel-consistency in all samples was quite very high.

- Sample E: control (100% WHT) had the highest total of lactic bacteria

Table 3: Amylose content and gel-consistency of the end-products

Finished samples	Amylose content (%)	Gel-consistency (mm)
Sample A	22,18±1,11	100±5,00
Sample B	23,80±1,19	100±5,00
Sample C	20,97±1,05	100±5,00
Sample D	23,27±1,16	100±5,00
Sample E (Control)	27,73±1,39	100±5,00

Table 4: Total lactic bacteria (CFU / g) and protein content in the end-products

End-products	Lactic acid bacteria (CFU/g)	Protein content (%)
Sample A	1.2×10^3	3.29±0,16
Sample B	1.3×10^3	3.45±0,17
Sample C	1.6×10^3	3.43±0,17
Sample D	2.1×10^2	3.24±0,16
Sample E (Control)	7.5×10^4	3.22±0,16

($7.5x10^4$ CFU/g). Samples A, B and C had similar for total lactic bacteria, sample D with the lowest total number of (2.1×10^2 CFU/g). Compared with the results from Table 4, the sample containing high quantity of WHT has high number of lactic bacteria (Sample E), If the sample was supplemented by BHR, and BDST have met the total lowest lactic bacteria.

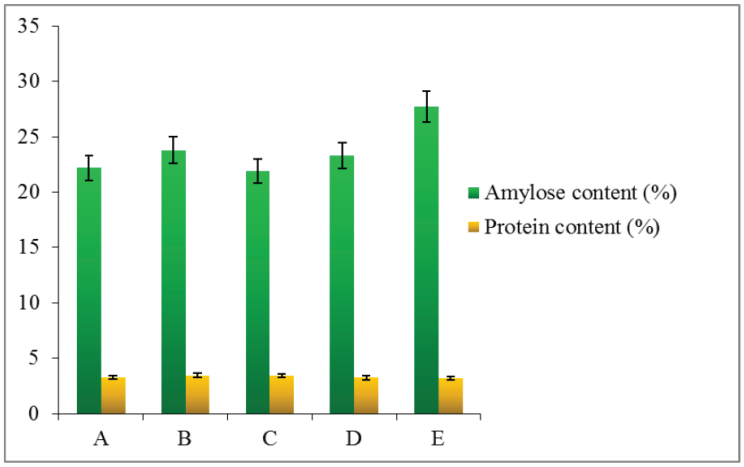

Diagram 2: Amylose and protein content in the end-products

- Based on the results in Tables 3, 4 and diagram 2, protein content of all samples reached 3.22 - 3.45%. The amylose content of sample E (control) was highest (27.73%).The remaining samples had the equivalent amylose content of 20,97 - 23,80%, these samples were used only 50 - 60% of WHT, the remaining

were supplemented by BHR, BDST and WhF made have a lower amylose content. Sample C had the lowest amylose content (20.97%) due to the addition of 10% WhF to the mixture.

3.4. Study on GABA fermentation conditions in the process of producing rice noodle

In order to produce GABA in rice noodle processing, we set up the two fermentation methods with different brown rice varieties as follows:

(1) Aerobic fermentation with the 3 rice varieties: BHT, BHR, BDST;

(2) Anaerobic fermentation with the variety BDST

Experimental and analytical results showed that GABA was also produced by both two fermentation methods for all the four rice samples in that the BHT reached highest content (214 mg/kg) with the aerobic fermentation method in natural conditions in Mekong River Delta.

Table 5: GABA content fermented bythe two methods of the different rice varieties

Samples	Fermentation methods	GABA content (mg/kg)
BDST	Aerobic	44,10
BHR	Aerobic	77,10
BHT (Brown rice HamTrau)	Aerobic	214,00
BDST	Anaerobic	38,30

3.5. Sensory evaluation of the end-products

All the end-products were sensitively evaluated based on the sensory quality standards (by TCVN 3251: 1979: Viet Nam National Standard) consisting of color, odor, taste, state, and acceptance level according to the Hedonic scoring method, the finally average results were shown in the following.

Table 6: Sensory evaluation of the end- products

Samples	Color	Smell	Taste	State	Acceptance
Sample A	7,00 ± 1,00	7,00 ± 1,15	6,86 ± 0,90	6,57 ± 0,79	6,86 ± 0,81
Sample B_1	7,71 ± 0,76	7,14± 0,69	7,29± 0,76	7,57 ± 0,98	7,50 ± 0,75
Sample B_2	7,14 ± 0,69	7,29 ± 1,11	7,14 ± 1,21	7,29 ± 0,95	7,36 ± 1,04
Sample C_1	8,14 ± 1,21	7,29± 0,95	7,43± 1,13	7,71 ± 1,11	7,50 ± 0,96
Sample C_2	7,36 ± 0,94	7,14 ± 1,07	7,14± 1,21	7,29 ± 0,49	7,07 ± 0,99
Sample D_1	7,86 ± 0,38	7,86 ± 0,69	7,86 ± 0,90	7,86 ± 0,69	8,07 ± 0,94
Sample D_2	7,50 ± 0,76	7,29 ± 0,95	7,14± 1,21	6,93 ± 0,93	6,93 ± 1,22
E (control)	7,71 ± 0,95	6,43± 0,79	7,00 ± 0,82	7,86 ± 1,07	7,21 ± 1,21

Total sensory evaluation results showed that all samples achieved sensory scores over average level (higher than 5 points). Particularly the sample D1 (60% of WHT, 20% of BHR and 20% of BDST), after 24 hours fermentation, no supplement of WhF) attained the highest sensory evaluation in terms of

color, smell, taste, state and acceptable level with the highest score (8.07/9 points maximum).

3.6. Quality assessment of the end-products

Regarding experimental rice varieties:

(01) WHT had the highest amylose content (26.59%) and average gel-consistency (52.33 mm) used as a raw material is too suitable for rice noodle production.

(2) BDST had amylose content of 19.20%, which can be used to produce rice noodle.

(3) WhF with very low amylose content (12.87%), no need to suplemented to the mixture of rice because this will make reduce amylose content of the mixture (sample C).

(4) Soaked duration 24 hours is the best time to attain highest total of lactic bacteria, followed by BDST and lowest is BHR.

For the end - products:

- Amylose content: Treatment E (control) had the highest amylose content of 27.73%, samples A, B and D had similar amylose content of 22.18 - 23.80%. The lowest amylose content was 20.97% due to the addition of 10% WhF to the mixture. However, with the amylose content of over 20%, all samples are suitable for the production of rice noodle.

- Totalmunber of Lactic bacteria: Treatment E had the highest total number of lactic bacteria (7.5x104 CFU / g), samples A, B, C also reached equivalent values (1.2x103 - 1.6x103 CFU / g), Treatent D has the lowest value of 2.1x102 CFU / g.

- All samples attained the equivalent protein content (3.22 3.45%).

- Particularly the sample D (60% WHT + 20% BHR + 20% BDST) with 24 hours fermentation, without WhF was enaluated as the best quality with highest score in color, smell, taste, state and acceptance level. The remaining samples achieved sensory scores over the average acceptance level (> 5).

4. Preliminary Conclusion

Results of the last research showed that:

(1) Biochemical properties of the rice varieties and their mixture formula clearly and strongly influenced on quality of the end-product responding to the national standards of Vietnam (TCVN), namely all the 03 rice varieties experimented BHT, BDST & BHR can be used to process rice noodle with different mixture formula in such a way that the final mixture must reach the amylose content from 20 to 27%.

(2) Gluten free rice noodle was successfully produced from the mixture of the different rice varieties without WhF, and met the requests both sensory and physico-chemical under the National Standards of Vietnam (TCVN).

(3) Essentially, GABA was produced with high content (214 mg/kg) in the brown rice material by the aerobic 24 hours fermentation method in natural condition in Mekong River Delta, Vietnam Therefore, it can be concluded that the GABA and GLUTEN FREE rice noodle was successfully produced for the first time in Vietnam.

Acknowledgments Korea Food Research Insittute funded for our research

References

[1] Hien Phan Phuoc (2009): *Méthodes d'analyse et d'expérience Biochimique moderne. Rapport du stage de perfectionnement du cours d'enseignement,* École Nationale Supérieure d'Agronomie et des Industries Alimentaires, Nancy (ENSAIA), Institut National Polytechnique de Lorraine: INPL, Nancy France12/2005, Nhà xuat ban Nong nghiep Viet Nam, Chi nhánh TP.HCM, 2009.

[2] Phan Phuoc Hien, Jong Dea Park (2012): *Further survey and improve practical process of special products prepared from Vietnamese rice to focus on better process and higher quality,* scientific final report of the KFRI-NLU project in bilateral cooperation between KFRI Korea and NLU Vietnam (2010-2012).

[3] Phan Phuoc Hien, Jong Dea Park (2014), *Research on the change of Biochemical Characteristics in Processing Traditional Vermicelli Prepared from Vietnamese and Korea rice,* published online on the Proceedings of the 2nd AFSA Conference on Food safety and Security organized by Asian Food Safety and Security Association (AFSA), August 15-17th, 2014. ISSN: 2306-2150.

[4] Phan Phuoc Hien, Jong Dea. Park (2014), *Research on the change of biochemical characteristics in processing traditional vermicelli prepared from Vietnamese and Korea rice,* Poster presentation in Postharvest biochemistry I section and published by the Abstract in Program of the 3rd Asia Pacific Symposium on Postharvest Research, Education and Extension (APS 2014), December 9-11th 2014, Ho Chi Minh City, Vietnam, p.42.

[5] K.Rea, T.I.F.H Cremers and B.H.C. Westerinks (2005), *HPLC conditions are critical for the detection of GABA by microdialysis,* Journal of Neurochemistry 2005, 94,672-679.

[6] TCVN 3251: 1979 Food products sensory analysis - Method of scoring.

[7] TCVN 5716-2: 2008: Rice - Amyloze content.

[8] TCVN 8369: 2010 White rice - Determination of gel strength.

[9] TCVN 7906: 2008 Microorganisms in food and animal feed - Medium temperature lactic acid bacteria quantification method - Colony count technique at 30^0C.

[10] Phan Phuoc Hien and Jong Dea Park (2017), *Effect of Biochemical properties and changes of rice material on quality in processing rice noodle in Vietnam,* KoSFRoST International Symposium and Annual Meeting: "The role of Food Scientists & Food Industries for Food security" Oral presentation in International Symposium S1: Use of Carbonhydrates to improve desirable properties in Foods.