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Rice Quality Criteria for new uses

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Abstract

The rice industry today has been thrust into an increasingly competitive, market-oriented, consumer-driven global economy. Thriving in both domestic and export arenas requires not only more efficient production and milling, but also capturing the whole value of the kernel. Capturing the whole value necessitates having :

- 1) a better understanding of customers' needs for rice with specific sensory, nutritional, and processing qualities and,
- 2) value-added applications for rice, its components, and coproducts.

Crucial is having the tools to rapidly, accurately, and objectively assess quality criteria needed for specific end-uses and markets.

This paper :

- 1) highlights the research we have undertaken at the USDA ARS Southern Regional Research Center (SRRC) in cooperation with other ARS, university, and industry scientists to develop methodologies to rapidly assess rice sensory and processing qualities and,
- 2) provides examples of new value-added applications we have developed at SRRC by capturing the unique functional properties of rice.

The paper concludes with a discussion of forums that are concerned with understanding and assessing rice quality for traditional and new uses.

Keywords

- Rice quality, sensory quality, new uses, value-added products, NIR
- USA

Developing novel methodologies for rapidly assessing Rice sensory and processing Qualities

Conventionally, sensory and processing qualities of rice have been assessed by a combination of preference sensory and physicochemical property evaluations. Sensory evaluations are generally preference ratings of flavour and texture, with the emphasis on textural attributes. Tests for physicochemical properties typically include amylose, protein, moisture, fat content, alkali spreading value, amylographic gelatinization and paste viscosity characteristics, and water-uptake capacity. Through statistical methods, relationships between sensory and physicochemical properties are determined, allowing assessment of sensory quality for a target population or application.

In the 1980's, "taste" analyzers were developed in Japan as a tool for relating sensory and physicochemical properties. These taste analyzers convert various physicochemical parameters of rice into "taste" scores based on correlations between NIR measurements of key constituents (e.g. amylose, protein, moisture, fat acidity) and preference sensory scores. They provide rapid screening and are used by Japanese millers and wholesalers to grade rice, both domestic and imported. World-wide adaptation of such a "taste" analyzer would be desirable. However, the "taste" analyzers being used in Japan are not universal or objective, because they are based on preference sensory scores. A "taste" analyzer calibrated using preference sensory scores can only assess whether the rice has quality characteristics deemed desirable by the target population represented by the sensory panel (in this case the Japanese).

Development of a universal "taste" analyzer is possible if descriptive analysis sensory scores are used for calibration instead of preference scores. In contrast to preference evaluations, descriptive analysis is an objective methodology (Meilgaard et al. 1987). Descriptive analysis utilizes trained panellists who evaluate the intensities of various sensory attributes using a universal intensity scale for flavour and standard reference scales for individual texture attributes. Following calibration, panellists theoretically should give the same results for a given sample, regardless of nationality, age, or gender. A universal "taste" analyzer calibrated with descriptive analysis scores would provide an objective measure relating the intensity of rice sensory descriptors (attributes) with physicochemical measurements. The "taste" scores provided by this universal analyzer could then be related to preference scores to identify quality characteristics desired by various domestic and international markets.

In 1994, I helped establish a collaborative project with the objective of developing this universal "taste" analyzer. Collaborators on the project include ARS scientists at the Rice Quality Laboratory (Beaumont, Texas), Richard B. Russell Research Center (Athens, Georgia), and Southern Regional Research Center; and breeders at the University of Arkansas (Stuttgart, AR), Louisiana State University (Crowley, LA), California Cooperative Rice Research Foundation (Biggs, CA), and the ARS Rice Quality Laboratory. International scientists at the Korean Food Research Institute (Kyonggi-do, Republic of Korea), National Food Research Institute (Tsukuba, Japan) and Ricegrowers Cooperative (Leeton, Australia) have also participated. Initial studies examined the influence of postharvest handling and processing parameters on the flavour and texture of cooked rice and established that NIR would be feasible for development of a method for assessing cooked rice texture. A study is currently being conducted to develop the NIR method using a set of 100 samples containing diverse varieties from the U.S., Japan, Taiwan, Korea, and Australia. At the end of September, 1997, our panellists completed descriptive analyses of these samples for the assessment of their flavour and textural attributes. Descriptive scores will be correlated using various multivariate and neural networks to NIR spectra and compositional data (determined by chemical and chromatographic means) to establish the universal "taste" analyzer. Models will also be developed to test for factors that explain rice sensory quality as a function of composition.

Rice Quality Criteria for new uses

Efforts at the SRRC directed at developing value-added products have led to new biochemical understanding of rice components (protein and starch) and new value-added applications for rice, e.g. a novel hypoglycaemic material, a fat-replacer, a resistant-starch product (functional fibber), protein concentrates, rice-based fries, extruded rice-containing biocontrol agents, and activated carbons. The following overview describes how we have captured the unique properties and functionalities of rice components in developing several of these new applications. Examples of quality criteria that need to be considered for each application are given.

Novel Hypoglycaemic Material/Fat Replacer

Carbohydrate-based foods with low glycemic index are beneficial to diabetics and athletes. The addition of carbohydrates to sports beverages has been recognized as being beneficial in maintaining blood glucose concentration and carbohydrate oxidation during the later stages of exercise. Rice flour with its bland flavour and nutritionally valuable protein serves well as the carbohydrate in such products. At SRRC, we have developed a novel hypoglycaemic material that digests at 50% the rate of untreated rice flour, as determined in vitro. The viscosity of the material can be controlled through processing. Low viscosity material is suitable for applications such as sports drinks and beverages and yoghurt-like foods for diabetics. The material can also be prepared to be solid with fat-like properties and will thus serve well as a fat-replacer in products such as margarine, whip cream, and sour cream. Specific functional properties (e.g. gel strength, adhesiveness, viscosity) of the materials are dependent not only upon amylose content of the cultivar, but also on the chain length and branched structure of the starch.

Novel Rice-Based Fries

Fries utilizing rice milling coproducts (broken kernels and bran) are in development. The desired product is a fry with the appearance and texture characteristics (soft interior, crisp outer surface) of french-fried potatoes. The research challenge has been to overcome textural problems (tough and chewy or sticky) in the extruded product. Fries prepared from waxy flour retained the most water after frying and had a soft interior texture similar to that of potato fries. However, they were sticky. In contrast, fries prepared from non-waxy varieties were hard and chewy. Hardness and chewiness correlated negatively with water contents of the frozen and fried rice-based fries, which in turn correlated negatively with protein and amylose contents. Through selection of rice with the appropriate amylose/protein profile and engineering feats, recent research has resulted in a "near perfect" product. The rice-based fries have a soft interior, crisp outer surface, and 25-50% less fat than conventional potato fries when fried. Being an extruded product, they can be fortified with vitamins and minerals.

Protein Concentrates

The high nutritional value and hypoallergenicity of rice proteins make them attractive for use in formulas for infants allergic to milk or soy proteins. Rice proteins, however, have poor solubility and are difficult to isolate from milled rice and bran. In the endosperm, protein bodies are closely associated with the starch granules. They are closely packed between starch granules, in the membranes covering the starch granules, and in the cell walls. Comprehensive investigations involving use of various solvents and enzymes for separation of protein from milled rice and defatted bran are underway at SRRC. These investigations have provided basic scientific information concerning protein structure and the interactions of protein with starch and other components that make protein isolation from rice so difficult. In one study, we explored the effectiveness of various solvents in solubilizing rice bran proteins and found cultivar differences. For example, a strongly dissociating solvent (cetyltrimethylammonium bromide) solubilized over 90% of the protein in defatted Cypress bran compared to 65% of the bran protein in Toro II. Extensive cross-linking through disulphide bonds appeared to be the likely force responsible for the observed insolubility of Toro II proteins. We concluded that characterizing the molecular state of the protein in the material appears to be an important first step in choosing a rice for protein isolation.

Rice-based Batters

Research has been initiated to develop rice-based batters that fry crispy and have low oil-uptake properties. One consideration in developing these batters is using rice with a high amylose content. With high amylose, the starch is a better film-former and thus has better low oil-uptake properties.

Extruded Biocontrol Products

Extruded biocontrol products containing rice have been developed for killing parasitic weeds, such as dodder found in cranberry crops. Rice flour improves the ease of extrusion and the physical properties of the granules, compared to that formulated with wheat flour. Additionally rice flour improves the growth and viability of some fungi, possibly because the C/N ratio of the matrix is higher than that achieved with wheat. Whether compositional differences of cultivars influence viability is not yet known.

Rice Coproducts as Activated Carbons

Research is underway to convert rice hulls and straw to activated carbons to increase their value in the commercial marketplace. Rice hulls and straw are soft, compressible materials, but mixed with a binder and compressed into briquettes, they can be converted to harder, denser materials with a high lignocellulose and silica content. Because of these physical and compositional attributes as briquettes, they are good precursors for activated carbon production. Activated carbons have been developed to adsorb common metals (zinc, copper, lead, nickel) found in many wastewater sources. Activated carbons have also been developed from hulls and straw that have good adsorptive properties for organic colorants in raw cane sugar and therefore hold promise as decolorizing carbons in the sugar refining process. This research exemplifies value-added uses for rice where quality criteria are not an issue. The cultivar source of the hulls and straw is immaterial.

Forums concerned with understanding and assessing Rice Quality for traditional and new Uses

The Rice Utilization Workshop (RUW)

The RUW, sponsored by the ARS and USA Rice Federation, was founded to help establish and focus research programs aimed at addressing the challenges faced by the Industry in an increasingly, market-oriented, consumer-driven, global economy. The first workshop "Developing Innovative, Non-Conventional Uses for Rice" was held in August, 1993. This was followed by "Beyond the Tradition" in January, 1995, and "Value-Added Rice: The Future Is Now" in August, 1996. The RUW is a forum for current and potential users of rice and technical experts to discuss current research progress in developing new uses for rice and its coproducts, directions and opportunities for future research, and strategies for coordinating and solving research needs. Central to discussions are rice quality criteria required for new uses. The RUW workshops each have drawn 100 participants from within and outside the U.S., representing academic/government and industry/private sectors. Proceedings include summaries of research needs and directions stemming from group discussions, texts of presentation by invited speakers, and a resource section with information describing postharvest rice research programs at government and university facilities in the U.S., databases for accessing rice literature and CRIS projects, and a list of attendees. Copies of the Proceedings may be obtained by contacting me. The next workshop is scheduled for the fall of 1998.

Rice Milling & Quality Technical Committee

The Rice Milling & Quality Technical Committee of the American Association of Cereal Chemists (AACC) is responsible for deciding whether 1) analytical methods have the potential of becoming useful AACC

procedures for rice quality analysis and 2) a particular scientific area warrants further investigation in terms of methodology development. Proposed AACC methods are submitted to collaborative study and presented to the Approved Methods Committee (AMC) for approval. Presently, the AACC Approved Methods book contains three rice related items: "Glossary - Rice" (36-03A) which has terms defined specifically for rice; "Amylograph method of milled rice" (61-01); and "Determination of the pasting property of rice with Rapid Visco Analyser." At the September, 1996 annual meeting, the committee recommended that the amylose method for rice, which is a revamp of ISO method 6647, be submitted to the AMC at the 1997 annual meeting as a First Approval Method. This method has been commonly used by government and industry laboratories. Recently, laboratories have begun employing NIR for amylose determination. Before a standard NIR method can be developed, the Rice Milling & Technical Committee determined that an approved method should be in place to serve as the "wet" chemistry standard for the NIR. The Rice Milling & Quality Technical Committee has also discussed and begun drafting a method for preparation of white rice for laboratory tests. The purpose of the method is to standardize the milling of rice for use in quality test procedures; i.e., composition (amylose, protein, fat), alkali-spreading, amylographic gelatinization and paste viscosity, and water-uptake capacity.

In conclusion, critical to developing the tools needed to assess quality criteria for specific end-uses and markets for rice is communication and coordination of efforts among breeders, producers, millers, product developers, marketers, and production and postharvest researchers. The Rice Utilization Workshop and Rice Milling & Quality Technical Committee offer two opportunities for networking and establishing working research groups. I look forward to your participation.

References

(1) Meilgaard, J., Civille, G. V., and Carr, B. T. 1987. Sensory Evaluation Techniques, Volume II, 159 pp. CRC Press, Boca Raton, FL

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