Chapter 9

Application of Rheology in the Pasta Industry

David H. Hahn

The use of rheological methods in the pasta industry is very much in its infancy. Few, if any, pasta manufacturers utilize quality assurance (QA) tests based on the rheological properties of the raw materials. Consequently, the manufacture of pasta remains more an art than a science. Large, highly automated production lines still rely on the expertise of the extruder operator to determine the proper water:semolina ratios. In contrast, cereal chemists have used the rheological properties of durum wheat for many years to evaluate the potential of durum wheat varieties for pasta production. Most of the rheological methods used have been adapted from those used in the baking industry. These methods use the mixograph, farinograph, extensigraph, alveograph, amylograph, and sodium dodecyl sulfate (SDS) sedimentation test. Many researchers have shown that, as is the case for bread wheats, gluten strength is an important factor in making high-quality pasta products from durum wheat. For this reason, there is good justification for the use of these methodologies. They have not proved to be entirely satisfactory for predicting the pasta-making potential of flour or semolina, however. The best test of the potential of a wheat flour or semolina for pasta production remains to actually make pasta.

Objective rheological methods are not commonly used by the pasta industry as QA procedures to evaluate the quality of the finished pasta. Subjective evaluation of the cooking performance of finished product is done periodically by most pasta manufacturers. The use of objective techniques to evaluate the cooking quality of spaghetti has been used in the literature.

These tests appear to have promise as QA procedures for the pasta industry, ultimately replacing or supplementing subjective cooking tests. These tests have not been commonly used by the pasta industry, however. The main stumbling block for their widespread use is the cost of instrumentation.

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The ultimate test of the quality of a flour or semolina for pasta production is the eating quality of the finished pasta. Rheological methods are useful only in their ability to predict or measure this quality. To a great extent, the structure of fresh, dry, and cooked pasta determines the rheological and the physical properties of a pasta product. Because of this, an understanding of pasta manufacture and structure is essential in order to obtain rheological measurements of semolina and pasta quality. Therefore, this chapter first discusses pasta production and structure, and then reviews the status of rheological methods for evaluating pasta and the application of these methods in the pasta industry. Areas where new rheological techniques are needed by the pasta industry are then discussed.

PASTA PRODUCTION

Durum semolina, durum flour, and hard wheat flour are used to produce pasta products. High-quality pasta is made with 100% durum wheat milled into semolina. This pasta has a bright yellow color and the best eating quality. While additional ingredients (eggs, spinach powder, and tomato powder) can be added to color and flavor specialty pastas, this discussion deals only with pasta made with semolina and water.

Large, highly automated production lines are used to produce pasta commercially. Production rates range from a low of approximately 110 lb/hr to a high of approximately 7,000–8,000 lb/hr (Baroni, 1988). The basic equipment includes a continuous pasta press (mixer and extruder), shaker/spreader, predrier, final drier, and storage unit. Developments over the last few years have greatly improved production efficiencies and product quality. Most prominent among these developments are the use of Teflon®-lined dies, the increased use of high-temperature drying, the development of microwave drying, and the development of more precise automatic controls.

Mixing

Warm water and semolina are introduced into a twin shaft mixing chamber at a ratio to bring the moisture level to approximately 28–31%. Water to semolina ratio (i.e., optimum moisture) is determined by the extruder operator based on his experience. Operators use appearance in the mixer, appearance of the freshly extruded pasta and the load on the extruder motor to determine water level.

The two shafts of the mixing chamber rotate in opposite directions, creating a degree of back mixing. This action allows for thorough mixing and also