Food Chemistry/Microwave heating/Baking case study (Revised: 5/25/18)

https://ukrainefood.info/recipes/pastries/61-pumpkin-pie-with-raisins

An Apple Pie that will not brown!

Kyiv Baking Company is manufacturing frozen pies for baking in a conventional oven. They mix all-purpose flour, oil, salt sugar, shortening, and water in a Hobart mixer for 30-minutes to make the dough. Once the dough is rested, it is sheeted and folded into an aluminum pie pan that has been sprayed with a non-stick oil coating.

The filling is made by mixing mashed pumpkins, sugar, corn starch, cinnamon, salt, sugar, 33% cream, eggs, butter, honey, raisins and prunes and then bringing it to a boil in a steam kettle for 30 minutes. Once the filling is cooled, it is ladled into the pie pan with the crust. Then the top crust is put in place and the pie is packaged in a carton. The packaged pies are then frozen in a blast freezer at 0F (-20C) for 4 hours.

The baking instructions on the package are: Bake 15 minutes at 425 degrees F (220 degrees C). Reduce the temperature to 350 degrees F (175 degrees C), and continue baking for 35 to 45 minutes.

The Customer Service rep mentioned that several customers were calling in to report that at the end of baking, the pies were not sufficiently browned. The manufacturing team is asking for your help in trouble shooting.

1. Describe the heat and mass transfer steps during baking of a pie.
2. What are the requirements for Maillard browning?
3. What ingredient related and processing related factors could have contributed to this problem?

The company would like your help to formulate a line of pies for use in the microwave oven.

4. What are the unique differences in microwave heating as compared to conventional heating?
    a. What are the formulation considerations for the crust?
    b. What are the formulation considerations for the filling?
    c. Can they still use the aluminum pan?