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Research In Brief

Exploring Producer Innovation Adoption Using an Extension-Led Trialing Program

Abstract

On-farm bacteriologic culturing (OFBC) provides quick and inexpensive mastitis diagnosis, but commercial adoption of this innovation has been low in Mississippi. We implemented an Extension-led trialing program to identify reasons for producers' lack of OFBC adoption, explore change in producers' knowledge and perceptions of OFBC, and assess the effectiveness of the program relative to OFBC adoption. Most producers were unaware of OFBC initially but identified several benefits after trialing it for 30 days. The methodology for designing and implementing a trialing program based on Rogers's diffusion of innovation framework was effective and could be replicated easily in other contexts.

Keywords: diffusion, innovation, adoption, technology adoption, dairy

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Introduction

There are approximately 65 dairy farms in Mississippi (Gregory, 2019) with an estimated annual milk value of $26 million (Mississippi Farm Bureau, n.d.). Mastitis is the most expensive disease in the dairy industry (Neeser, Hueston, Godden, & Bey, 2006) and can decrease milk production by 1,181 kg per lactation in multiparous cows (Wilson et al., 2004). Clinical mastitis accounts for the largest use of antibiotics in livestock species (Thomson, Rantala, Hautala, Pyörälä, & Kaartinen, 2008), a circumstance that raises concerns of antimicrobial resistance (Pol & Ruegg, 2007; Wang et al., 2015) and increases producer expenses due to purchasing antibiotics and discarding milk during treatment (Rollin, Dhuyvetter, & Overton, 2015). On-farm bacteriological culturing (OFBC) enables producers to distinguish among broad categories of microorganisms with great accuracy and provides results within 24 hr, versus approximately a week when cultures are sent to a laboratory (Down, Bradley, Breen, & Green, 2017). Despite the availability of several viable OFBC systems, adoption of OFBC in Mississippi has been limited.

The purpose of the study reported here was to implement and evaluate an OFBC pilot test with a small sample of Mississippi dairy producers. The objectives of the study were

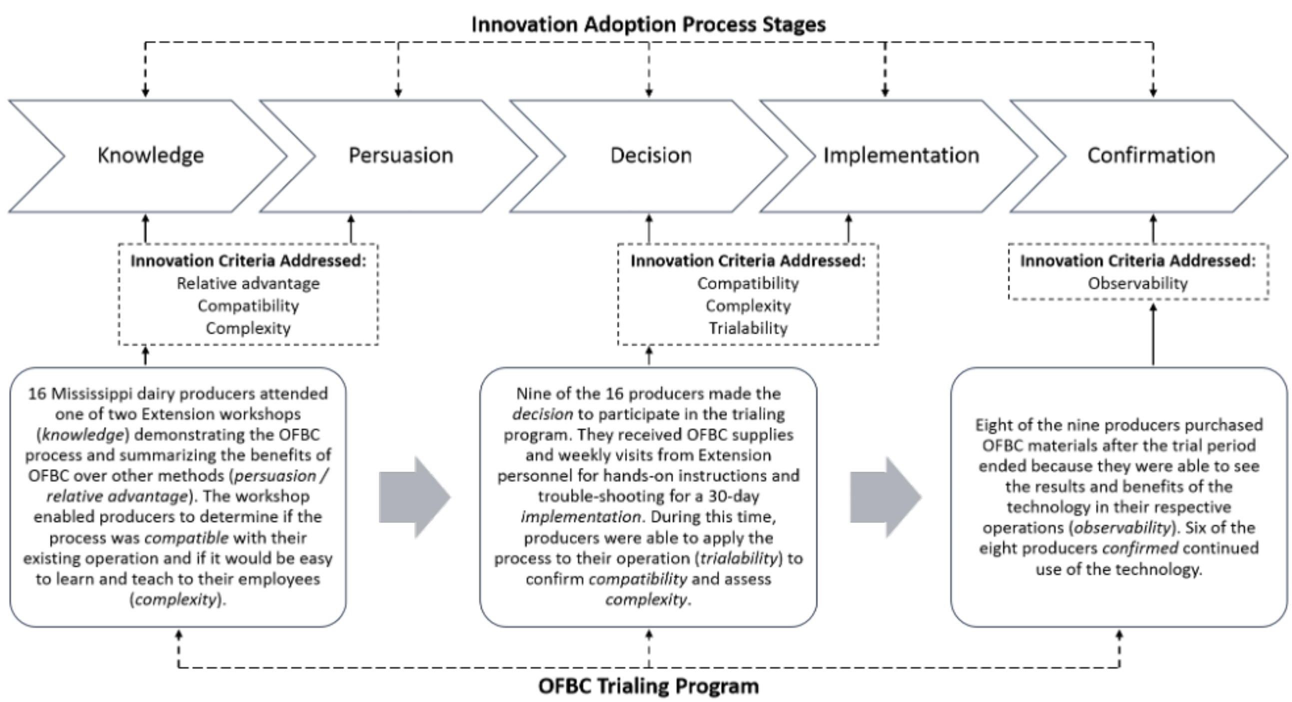
- to identify reasons for producers' lack of OFBC adoption,

- to explore change in producers' knowledge and perceptions of OFBC before and after trial, and
- to assess the effectiveness of an Extension-led trialing program relative to OFBC adoption.

Conceptual Framework

To address the objectives stated above, we developed a short-term pilot project incorporating Rogers's (1995) five-stage innovation adoption process—knowledge, persuasion, decision, implementation, and confirmation—while addressing the criteria potential adopters use to evaluate an innovation—relative advantage, compatibility, complexity, trialability, and observability. According to Rogers (1995), the decision process for adopting or rejecting an innovation is based on steps in a five-stage process: The individual must become aware of the innovation (*knowledge*), develop an attitude in favor of or against the innovation (*persuasion*), engage in "activities that lead to a choice to adopt or reject the innovation" (p. 20) (*decision*), actually use the innovation (*implementation*), and either uphold or change his or her previous decision (*confirmation*). Rogers (1995) also purported that an innovation is more likely to be adopted and at a faster rate if it is perceived to be better than the current method or tool being used (*relative advantage*), is "consistent with the existing values, past experiences, and needs of potential adopters" (p. 15) (*compatibility*), requires less effort to understand and use (*complexity*), can be tested (*trialability*), and can readily demonstrate visible results (*observability*). Figure 1 illustrates components of the OFBC trialing program we implemented and their alignment to the stages of innovation adoption and innovation evaluation criteria.

Figure 1.
Alignment of On-Farm Bacteriological Culturing (OFBC) Trial with Adoption Process Stages and Innovation Evaluation Criteria



Materials and Methods

We invited all Mississippi dairy producers (*N* = 68) to attend one of two Extension OFBC workshops in June 2017. Sixteen producers (23.5%) attended at least one workshop. Topics included the dangers and consequences of mastitis along with the management and economic benefits of OFBC. We then provided a demonstration of the OFBC process, including the aspects of identifying and managing herd health issues.

After each workshop, we solicited volunteers to participate in a pilot program that would allow them to trial the OFBC technology for 30 days with their own herds. This trialing program enabled producers to personally investigate OFBC's characteristics and weigh OFBC against their current management practices. Nine producers agreed to participate in the trial.

We visited each participating producer five times between June 28 and July 31, 2017. At the first visit, we distributed OFBC supplies and a questionnaire, reviewed the OFBC procedure with producers, and placed example tri-plates (University of Minnesota College of Veterinary Medicine Laboratory for Udder Health, St. Paul, MN) in an incubator to ensure that all materials were working properly. The questionnaire addressed producers' perceptions of OFBC as well as producers' perceptions of their own innovativeness, or the degree to which one is likely to adopt a new idea (Rogers, 1995). We returned the next day to each operation to collect the completed questionnaires, assist producers in reading materials from the example tri-plates, and answer any remaining questions. Producers were encouraged to collect and culture samples from cows showing clinical signs of mastitis. Subsequently, we made four weekly follow-up farm visits to assess changes in producers' perceptions and use of OFBC through a weekly questionnaire, answer producer questions, and resupply OFBC materials as needed.

During the final visit, a postproject questionnaire again addressed producers' perceptions of OFBC and included additional questions about how producers planned to use OFBC after the study ended, what aspects of OFBC still caused them discomfort, and what suggestions they had for improving the marketing of OFBC to producers in the future. At this time, we also asked producers to either purchase their remaining supplies at half price or return them to us at no cost. Two weeks later we notified the purchasing producers that their checks would be voided and they could keep the supplies at no cost. Although the producers' responses and actions regarding purchasing the supplies did not guarantee long-term adoption, they did provide insight into their short-term decision and intent to implement OFBC.

Results and Discussion

Nine producers with pasture-based dairies participated in the OFBC trialing program after attending an Extension workshop. The most common reasons producers cited for enrolling in the study after attending the workshop were that they wanted to learn about mastitis management (f = 7) and that they considered the study to be a way to begin using OFBC as quickly as possible (f = 7). Other reasons included to seek mentorship from Mississippi Extension to learn the procedure (f = 5), to obtain free materials (f = 2), to test OFBC before purchasing supplies (f = 2), to learn about Cooperative Extension in general (f = 1), and "Other: to be innovative and take part in innovative projects" (f = 1).

Although it was not possible to make a direct association between producers' adopter categories (Rogers, 1995) and their intent to adopt OFBC, it was interesting to see where they identified themselves along the adopter spectrum. Six producers self-identified as early adopters, and three claimed to be either early or late majority. One producer reported typically implementing a new practice within 1 to 4 weeks, five producers within 1 to 6 months, and one within 7 to 12 months.

Objective 1: Identify Reasons for Producers' Lack of OFBC Adoption

When asked via the first questionnaire why they had not yet adopted OFBC, eight producers said they were unaware of OFBC, and one producer reported having heard of OFBC but being unsure of how to obtain materials. At the beginning, producers were asked to indicate their levels of agreement regarding whether OFBC would affect treatment and management of mastitis (1 = *disagree* to 5 = *agree*). At the end of the study, they were asked the same question. Means plus or minus standard deviations of the data from the nine responding producers were 4.67 ± 0.50 at the beginning of the study and 3.78 ± 1.72 at the end, indicating less consistent agreement regarding the effect of OFBC after the trialing experience. Although the majority of producers ($f = 5$) agreed at the end of the study that OFBC influenced treatment and management decisions, the degree of influence they ascribed to OFBC varied. Two producers reported that OFBC had "a lot" of influence on farm decisions, five reported that it had "very little" influence, and two reported that it had no influence.

Objective 2: Explore Change in Producers' Knowledge and Perceptions of OFBC Before and After Trial

At the beginning of the study, producers ($n = 7$) estimated that OFBC would save on average $466 per clinical mastitis case, but by the study's end that value was only $94. This result is indicative of a learning process as producers became familiar with using OFBC. Producers' initial estimates of how much money would be saved per clinical mastitis case were greater than what could actually be achieved. This circumstance may indicate that producers did not understand mastitis costs or the potential economic benefits of OFBC. This result also may explain some producers' disappointment in OFBC during the study because expectations were too great from the beginning.

Pre- and postproject perceptions of OFBC remained relatively constant over the study period. The positive innovation characteristics selected by producers included reduced antibiotic expense, prevention of the release of harmful endotoxins into the cow's body, faster results than from a lab test, low cost, and help in identifying treatment protocol (*relative advantage, compatibility*, and *complexity*). Negative characteristics selected were delay of treatment that could result in problems for the cow and additional effort needed to obtain results of the OFBC test as opposed to sending samples to and receiving results from a lab (*complexity*). We also asked producers to identify and rank reasons for considering adoption of OFBC. Improved cow health was ranked as the most common reason for considering adoption, followed by reduced risk of antibiotic residues and lower treatment cost. Producers ranked consistency in mastitis management and treatment as the least important reason.

Objective 3: Assess Effectiveness of an Extension-Led Trialing Program Relative to OFBC Adoption

Eight producers purchased OFBC materials after the study ended, with six planning to continue using OFBC in the same manner as during the study and two planning to decrease use. Of those eight producers, five planned to use OFBC on cows with visible signs of mastitis, two planned to use OFBC as needed or when mastitis was suspected, and one planned to use OFBC for fresh cows or heifers that calved while having clinical mastitis. The producer who chose not to purchase the OFBC materials expressed concern that the system "gave cows mastitis," which is concerning as this scenario is not actually possible. This perception may indicate the need for additional Extension-led workshops and demonstrations on OFBC as well as a longer trialing period to ensure producers' understanding of the technology.

A limitation of our pilot study was the small sample size, meaning that the results of the farmers' knowledge and perception questionnaires are not generalizable to the larger population of dairy producers in the state. However, the methodology for designing and implementing an Extension-led trialing program based on Rogers's diffusion of innovation framework was effective and could be replicated quite easily in other contexts. The producers attending the workshops and participating in the study were interested in learning more about the trialed system. Producers were not previously aware of OFBC, implying that Extension personnel in Mississippi could do a better job disseminating relevant information to producers.

Another limitation was the short implementation timeline, which was necessary given the restricted availability of the undergraduate researcher on our team who assisted with design, implementation, and analysis of the data. Producers seemed to become comfortable in incorporating OFBC within the month of the study, but extending the duration for future trials may enhance producers' willingness to confirm sustained adoption of OFBC. Additionally, producers may see the financial benefit of Extension dairy programs if they use the programs long-term (Hohmann & Ruegg, 2012).

Conclusions

OFBC has the potential to be a valuable tool in dairy producer education related to milk quality and udder health as it can help producers visualize mastitis patterns in their herds, keep better track of udder health status in their herds, and potentially improve treatment and management decisions. Those conducting future research should expand OFBC trialing to dairies beyond Mississippi and to include examination of the effect on producer decisions relative to herd sizes, housing options, and management systems.

Programs such as the one described here that intentionally and systematically incorporate Rogers's diffusion of innovation framework have the potential to open doors for producers to trust and rely on Cooperative Extension for questions and help beyond the study topic. However, why and how producers make decisions surrounding innovation adoption remains unclear. Harder (2009) explained the importance of using "factors related to diffusion" as a way to "enhance our opportunities for success in Extension" (p. 3). We recommend a deeper, qualitative investigation of producers' perception of OFBC as an agricultural innovation for better understanding the specific factors influencing the long-term adoption of this particular technology (Hubbard & Sandmann, 2007). We also recommend replication of our trialing process with other types of producers and stakeholder groups familiar with Extension.

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