

Arkansas Beef Quality Assurance Refrigerator Demonstration¹

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Story in Brief

WatchDog data loggers were used to record the temperature at 10-min intervals for 48 h in 142 refrigerators of producers (73.2%), retail stores (20.4%) and veterinarian clinics (6.3%). The most common refrigerator tested was a refrigerator with the freezer-on-top (42.4%), followed by mini-refrigerators (21.1%), side-by-side refrigerators (19.5%), other types of refrigerators (16.2%), and freezer-on-bottom refrigerators (0.7%). The refrigerator ages were listed as ≤ 5 yr (22.5%), 6 to 10 yr (36.6%), 11 to 15 yr (21.3%), and > 15 yr (19.5%). The other category (57.0%) was the most common category for refrigerator location, followed by kitchen (16.2%), barn (15.5%), tack room (5.6%), mud room (4.9%), and porch (0.7%). Of the 4,665 animal health products stored in refrigerators, 3.5% were expired, and 8.7% were opened. Over 38% of the refrigerators contained human food, whereas 59.7% of refrigerators contained drinks for human consumption. The majority (52.1%) of the refrigerators surveyed contained beef cattle animal health products, whereas 47.9% of the refrigerators contained beef cattle and other livestock animal health products. The only differences detected were due to refrigerator location ($P < 0.05$). Refrigerators located in a mud room had a higher ($P < 0.05$) average temperature, fewer ($P < 0.05$) points below 35°, more ($P < 0.05$) points above 45°, fewer ($P < 0.05$) percentage points below 35°, and more ($P < 0.05$) percentage points above 45°. As a result of this study, livestock producers should monitor the refrigerator temperature where animal health products are stored.

Introduction

The Arkansas Beef Quality Assurance Program (BQA) is an educational program that illustrates the importance of proper handling and administration of animal health products. One BQA recommendation is to store animal health products at the proper temperature (Arkansas BQA Handbook, 2006).

Refrigeration is required for most animal health products (antibiotics, pharmaceuticals, biologicals, vaccinations, etc.). Biological products should be kept under refrigeration between 35° to 45°F (2° to 7°C) unless the inherent nature of the product makes storage at a different temperature advisable (APHIS, 2007). Storing animal health products $< 35^\circ\text{F}$ can be more damaging than storing animal health products $> 45^\circ\text{F}$ because the antigen can separate from the adjuvant. Producers are very good about storing animal health products in a refrigerator. These refrigerators are often older models and are located outside, in a tack room, near the working chute, in barns, and/or out in the elements. Given these situations, maintaining proper temperature for animal health products becomes a genuine concern.

Therefore, the objectives of this study were to determine the temperature of refrigerators where animal health products are stored and to conduct an animal health product inventory to determine if any products were opened or expired.

Experimental Procedures

To record temperatures of refrigerators containing animal health products, 10 WatchDog data loggers (Model 100 8K) and Spec 8 Basic software (Spectrum Technologies, Inc., Plainfield, Ill.) were purchased. Data loggers were programmed to record the temperature at 10-min intervals for up to 56 d and are accurate to $\pm 1^\circ\text{F}$

($\pm 0.6^\circ\text{C}$). WatchDog data loggers were loaned to county extension agents, and agents placed the data loggers in refrigerators of producers, retail stores, and veterinarian clinics. The WatchDog data loggers remained in the refrigerator for 48 h before being returned for summary and analysis. Once the data were summarized, the temperature results were sent to the county agent, who forwarded the information to the producer, store manager, or veterinarian.

In addition, county agents conducted a survey for each refrigerator tested, including refrigerator location (barn, tack room, porch, mud room, kitchen, and other), type of refrigerator (side-by-side, freezer-on-top, freezer-on-bottom, mini-refrigerator, and other), refrigerator age (≤ 5 yr, 6 to 10 yr, 11 to 15 yr, and > 15 yr), the date and time the WatchDog was placed and removed from the refrigerator, number of animal health products in the refrigerator, number of animal health product that were expired and/or open, and human food or drink items in the refrigerator. Also, the presence of any animal health products for other species other than bovine was noted.

Each refrigerator sampled contained 288 temperature data points (48 h measured every 10 min) and each data point was analyzed to determine if it was over or under the critical temperatures of 35° to 45°F. All 288 data points for each refrigerator were averaged to produce a mean temperature and percentage of observations that were below and above the critical temperatures. These summarized data were analyzed using ANOVA, JMP v7.0.1 (SAS Inst., Inc., Cary, N.C.) with dependent variables of mean temperature, percentage of time over critical temperature and percentage of time below critical temperature using individual refrigerators as the experimental unit. Independent variables analyzed included refrigerator owner (producer, retail store, or veterinarian), location of refrigerator (barn, tack room, porch, mud room, kitchen, and other), type of refrigerator (freezer-on-top, side-by-side, freezer-on-bottom, mini-refrigerator, and other), and age of refrigerator (≤ 5

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yr, 6 to 10 yr, 11 to 15 yr, and > 15 yr). When a significant F-test was observed, least squares means were separated utilizing t-tests.

Results and Discussion

The majority of the refrigerators tested were producer's refrigerators (73.2%), with 20.4 and 6.3% found in retail stores and veterinarian clinics, respectively. Producers were not identified as to what type of producer (i.e. cow-calf, stocker, dairy, equine, etc.). The most common refrigerator was a refrigerator with the freezer-on-top (42.4%), followed by mini-refrigerators (21.1%), side-by-side refrigerators (19.5%), other types of refrigerators (16.2%), and freezer-on-bottom refrigerators (0.7%). The front glass/display case refrigerator was the most common refrigerator in the other category. Refrigerator ages were listed as ≤ 5 yr (22.5%), 6 to 10 yr (36.6%), 11 to 15 yr (21.3%), and > 15 yr (19.5%).

Other (57.0%) was the most common category for refrigerator location. The other locations listed included within a store (33.8%), office (25.7%), workshop (18.9%), and garage (13.5%). Additional refrigerator location categories included kitchen (16.2%), barn (15.5%), tack room (5.6%), mud room (4.9%), and porch (0.7%).

The majority (52.1%) of the refrigerators surveyed contained beef cattle animal health products, whereas 47.9% of the refrigerators contained beef cattle and other livestock animal health products. Of the 4,665 animal health products stored in refrigerators, 3.5% were expired, and 8.7% were opened. Over 38% of the refrigerators contained human food including milk (11.7%), eggs (10.3%), cheese (8.3%), fruit (8.3%), and vegetables (7.6%). Furthermore, almost 60% of refrigerators (59.7%) contained drinks for human consumption, particular soft drinks (42.1%), water (28.3%), Gatorade® (9.2%), beer (8.6%), and fruit/juice drinks (7.2%).

Average temperature, number of data points below 35° and above 45°F, and the percentage of data points below 35° and above 45°F for owners (producers, retail stores, or veterinarian clinics), refrigerator location, refrigerator type, and refrigerator age are summarized in Table 1. The only differences detected were due to refrigerator location ($P < 0.05$). Refrigerators located in a mud room had a higher ($P < 0.05$) average temperature, fewer ($P < 0.05$) points below 35°, more ($P < 0.05$) points above 45°, fewer ($P < 0.05$) percentage points below 35°, and more ($P < 0.05$) percentage points above 45° than refrigerators located in a barn, tack room or other location, but not for refrigerators located in a kitchen. It appears refrigerators located in heated and cooled rooms (kitchen and mud room) maintained warmer temperatures. There was a trend ($P < 0.30$) for refrigerators ≤ 5 yr and 6 to 10 yr to be cooler than refrigerators 11 to 15 yr and > 15 yr old.

Although it's important to analyze the overall data, individual refrigerator information is critical in determining whether or not any given refrigerator is storing animal health products at the proper temperature. Figure 1 depicts an example of a refrigerator where temperature varied very little, maintaining the temperature between 35° and 45° over a 24-h period. Conversely, the refrigerator example in Figure 2 also kept the temperature between 35° and 45° but the variation was substantially greater when compared to the refrigerator in Figure 1.

After the Watchdog data logger was inserted into the refrigerator in Figure 3, it took approximately 7.5 h before the temperature dropped below 45°F. Figure 4 is an example of a refrigerator that kept the temperature too cold with all but 2 datum points blow 35°F across the 24-h observation period. Moreover, there was almost a 10°F variation in 50 min throughout the 24-h period (Figure 4). Storing animal health products at temperatures < 35°F can be more damaging than storing animal health products at temperatures of > 45°F, because the antigen can separate from the adjuvant.

Figure 5 illustrates a refrigerator set too warm with all of the data points 10 to 15° above 45°F. It is not advisable to store animal health products at this temperature, and it was recommended to the producer to dispose of all animal health products stored in this refrigerator.

The refrigerator in Figure 6 illustrates 2 points. First, temperature varied from approximately < 45° to < 30°F during the first 12 to 14 h after data logger insertion. It appeared the condenser was on an approximately 1-h defrost cycle causing the temperature variation. Secondly, refrigerator temperature got as low as < 30°F 5 times in 24 h.

All refrigerators require general maintenance, and it is important to keep the refrigerator coils clean. Refrigerator coils are located in the rear of the refrigerator and can be cleaned by vacuuming the vents and coils. Dusty coils have to work harder to cool down the interior and contents of the refrigerator.

The drip pan, located beneath the refrigerator, should also be cleaned. In automatic defrost models, the water from the defrost process flows out a drain in the floor of the refrigerator and into a pan where it sits until evaporating. Food particles can be carried along and clog the drain or be left behind to rot. You can clear out the tube that carries particles to the pan by removing the stopper at the opening. Stick a pipe cleaner or similar device into the opening to push any particles through to the pan. Flush with soapy water and then empty and clean the pan.

The gaskets are the seals that keep cold air in and the room air out of the refrigerator, and the gaskets should last the life of the refrigerator if properly cared for. Gaskets should be washed with soapy water, and the "paper test" can be used to test the condition of the gasket. You should not be able to slide a piece of paper between the rubber seal and the wall of the refrigerator. If the piece of paper slips between the seal and the wall, the seal is not tight enough and the gasket requires replacement.

Consider the location of your refrigerator and/or freezer. Do not position them in direct contact with hot appliances as this will make the compressor work harder. Regularly defrost manual-defrost freezers, never allowing frost to build up more than 0.25 in.

Implications

This demonstration assisted producers in determining if they are storing animal health products according to labeled instructions. When animal health products are stored incorrectly, the effectiveness of animal health products may become compromised. All animal health products that are past their expiration date or opened should be disposed of properly.

Literature Cited

APHIS. Title 9 – Animals and Animal Products. Chapter I, Part 114
– Production requirements for biological products. 2007.
Code of Federal Regulations. Title 9, Volume 1.

Arkansas Beef Quality Assurance Handbook. 2006. Fourth Edition.
Editors: T.R. Troxel and J. Powell. University of Arkansas
Division of Agriculture Cooperative Extension Service. Little
Rock, Ark.

Table 1. The least square means (\pm SE) for average temperature, number of data points below 35° and above 45° F, and the percentage of data points below 35° and above 45° F stratified across refrigerator owners, refrigerator location, refrigerator type and refrigerator age.

| Item | Average temperature | Number of points below 35° | Number of points above 45° | Percentage of points below 35° | Percentage of points above 45° |
|----------------------|--------------------------------|---------------------------------|--------------------------------|---------------------------------|--------------------------------|
| Owner: | | | | | |
| Producer | 39.3 \pm 1.52 | 77.4 \pm 27.39 | 39.3 \pm 17.46 | 26.9 \pm 9.51 | 13.6 \pm 6.06 |
| Retail store | 40.8 \pm 2.23 | 50.2 \pm 40.16 | 43.6 \pm 25.61 | 17.4 \pm 13.95 | 15.1 \pm 8.89 |
| Veterinarian clinics | 41.6 \pm 2.74 | 52.5 \pm 49.30 | 94.0 \pm 31.44 | 18.2 \pm 17.12 | 32.6 \pm 10.92 |
| Location: | | | | | |
| Mud room | 45.1 \pm 2.96 ^a | 6.0 \pm 53.36 ^{a,b} | 128.4 \pm 34.02 ^a | 20.1 \pm 18.53 ^{a,b} | 44.6 \pm 11.82 ^a |
| Kitchen | 42.6 \pm 2.07 ^{a,b} | 8.8 \pm 37.28 ^b | 72.4 \pm 23.7 ^{a,b} | 3.0 \pm 12.95 ^b | 25.1 \pm 8.26 ^{a,b} |
| Other | 39.3 \pm 1.62 ^b | 83.9 \pm 29.07 ^a | 40.4 \pm 18.54 ^b | 29.2 \pm 10.09 ^a | 14.0 \pm 6.43 ^b |
| Barn | 38.6 \pm 2.24 ^b | 80.6 \pm 40.34 ^{a,b} | 34.6 \pm 25.72 ^b | 28.0 \pm 14.00 ^{a,b} | 12.0 \pm 8.93 ^b |
| Tack room | 37.3 \pm 2.87 ^b | 120.8 \pm 51.67 ^a | 18.9 \pm 32.95 ^b | 41.9 \pm 17.94 ^a | 6.6 \pm 11.44 ^b |
| Refrigerator type: | | | | | |
| Side by side | 38.4 \pm 1.81 | 90.6 \pm 32.59 | 43.4 \pm 20.78 | 31.4 \pm 11.32 | 15.1 \pm 7.22 |
| Freezer on top | 39.0 \pm 1.45 | 91.6 \pm 26.18 | 46.5 \pm 16.69 | 31.8 \pm 9.09 | 16.2 \pm 5.80 |
| Freezer on bottom | 43.0 \pm 6.59 | 18.0 \pm 118.67 | 37.1 \pm 75.67 | 6.3 \pm 41.21 | 12.9 \pm 26.3 |
| Mini refrigerator | 41.1 \pm 1.71 | 74.1 \pm 30.82 | 90.0 \pm 19.66 | 25.7 \pm 10.70 | 31.2 \pm 6.83 |
| Other | 41.4 \pm 1.91 | 25.8 \pm 34.31 | 77.7 \pm 21.88 | 9.0 \pm 11.92 | 27.0 \pm 7.60 |
| Refrigerator age: | | | | | |
| \leq 5 yr | 39.8 \pm 2.07 | 67.4 \pm 37.32 | 48.1 \pm 23.80 | 23.4 \pm 12.96 | 16.7 \pm 8.26 |
| 6 to 10 yr | 39.2 \pm 1.81 | 75.9 \pm 32.56 | 43.0 \pm 20.76 | 26.4 \pm 11.31 | 14.9 \pm 7.21 |
| 11 to 15 yr | 41.4 \pm 2.15 | 34.3 \pm 38.56 | 63.5 \pm 24.59 | 11.9 \pm 13.39 | 22.1 \pm 8.54 |
| >15 yr | 41.9 \pm 2.13 | 62.5 \pm 38.38 | 81.1 \pm 24.47 | 21.7 \pm 13.32 | 28.1 \pm 8.50 |

^{a,b} Within a column and category, least squares means lacking a common superscript letter differ ($P < 0.05$).

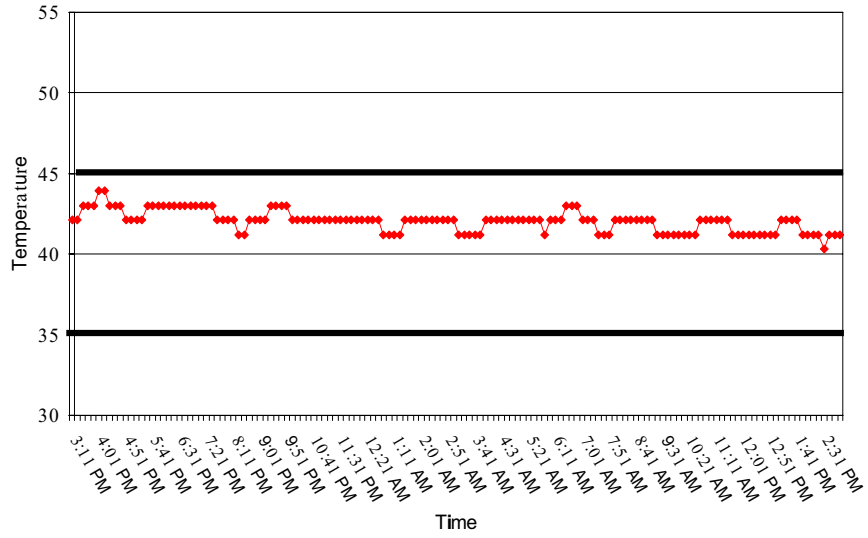


Fig. 1. An example of a refrigerator that kept a constant temperature between 35° and 45°F within a 24-h period.

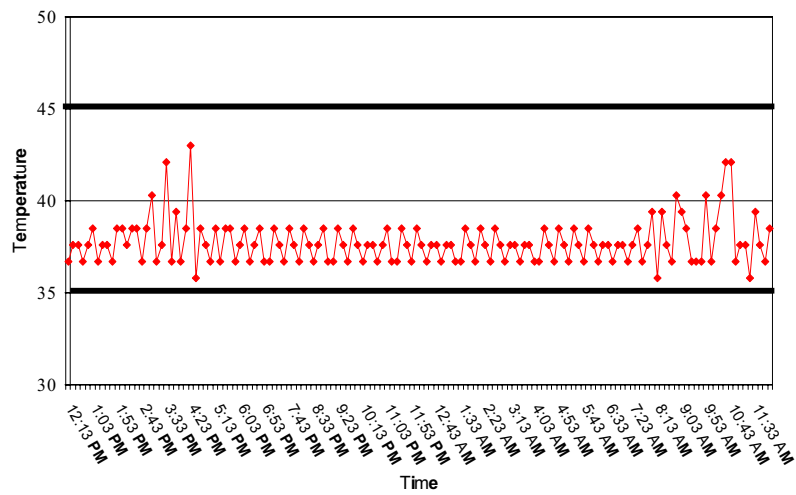


Fig. 2. An example of a refrigerator that kept the temperature between 35° and 45°F but showed some variation within a 24-h period.

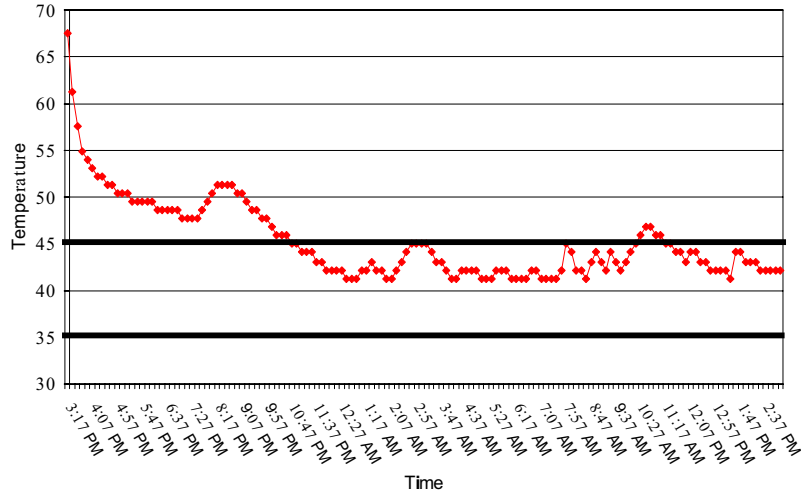


Fig. 3. An example of a refrigerator that took approximately 7.5 h before the temperature was below 45°F.

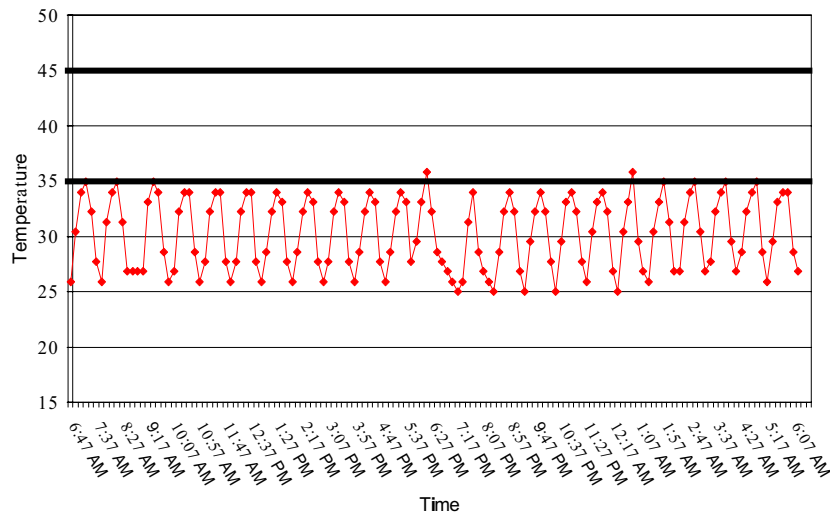


Fig. 4. An example of a refrigerator that kept the temperature below 35°F (except for two data points) and showed an approximately 10 degree variation every 50 min over a 24-h period.

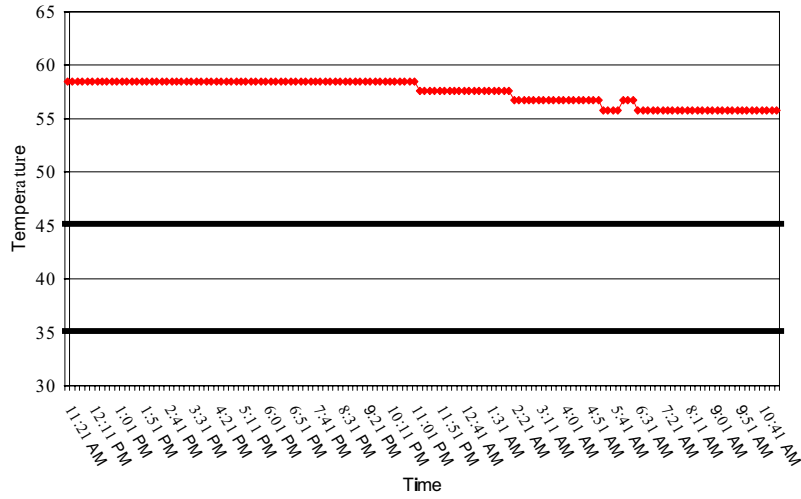


Fig. 5. An example of a refrigerator that kept the temperature above 45°F over a 24-h period.

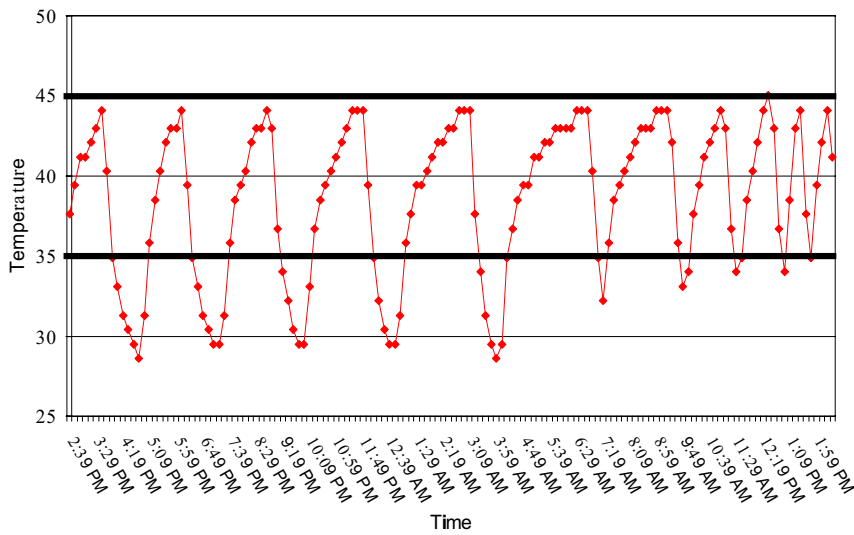


Fig. 6. An example of a refrigerator that demonstrated an approximately 15 degree variation every 2 h and dropped the temperature below 30°F 5 times over a 24-h period.

