

## **Project #5 Dakota Hops**

### **FINAL PROJECT REPORT TEMPLATE**

Final Performance Reports must illustrate the completion of each project within the grant agreement. Each project shall be outlined as separate project profiles. You will report on projects in the same order they were submitted in the approved application and subsequent amendments.

#### **PROJECT INFORMATION**

<b>Project Title</b>	Brewing Beer with Frozen Hops			
<b>Recipient Organization Name:</b>	Dakota Hops, LLC			
<b>Period of Performance:</b>	<b>Start Date:</b>	9/30/2018	<b>End Date:</b>	9/29/2022
<b>Recipient's Project Contact</b>				
<b>Name:</b>	Steve Polley			
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#### **PERFORMANCE NARRATIVE**

##### **PROJECT BACKGROUND**

*Provide enough information for the reader to understand the importance or context of the project. This section may draw from the background and justification contained in the approved project proposal.*

Dakota Hops, LLC had previously developed three new hop reservation methods for the brewing industry as alternatives to the standard kiln-drying preservation process, including mechanical (conventional) freezing of hops at 0 degrees Fahrenheit, cryogenic hops at -120 degrees Fahrenheit, and freeze-drying. This project aimed to build on previous testing of mechanical and cryogenic hop preservation methods, which had shown promise for producing more flavorful beer products. Dakota Hops, LLC and Black Hills State University partnered to continue testing on several fronts including use of freeze-dried hops, recipe development for beer brewed with frozen hops, and comparison of performance across hop varieties and hop harvest years. This grant also aimed to examine and answer the questions for the brewing industry of whether hops turn to mush or can be successfully preserved through freezing, whether beer can be brewed with frozen hops, and if so, what would be the final beer product results.

##### **ACTIVITIES PERFORMED**

*Address the below sections as they relate to the entire project's period of performance.*

##### **OBJECTIVES**

*Provide the approved project's objectives.*

#	Objective	Completed?	
		Yes	No*
1	Test/Develop/Refine Recipes for brewing with frozen hops/both mechanical and cryogenic methods, as no recipes currently exist.	X	
2	Conduct brewing trials on freeze dried hops produced by Dr. Padmanahan Krishnan, South Dakota State University. No tests have been conducted yet.		X
3	Compare test results from four different hop harvests (2015-2018).		X
4	Compare other hop varieties against the Cascade variety that was used for testing in the previous brewing trials	X	

*\*If no is selected for any of the listed objectives, you must expand upon this in the challenges and lessons learned sections.*

## ACCOMPLISHMENTS

*List your accomplishments for the project's period of performance, including the impact they had on the project's beneficiaries, and indicate how these accomplishments assist in the fulfillment of your project's objective(s), outcome(s), and/or indicator(s).*

#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
1	<p>Found hops can be successfully frozen at temperatures of -10 °F TO -350 °F. The hops do not turn to mush. The project demonstrated that hops can be frozen successfully over a wide range of freezing temperatures. The term “mush” is not defined by any of the authors responsible for the conclusion that hops will turn to mush if frozen, which this study sought to disprove.</p>	Objectives 2 and 3
2	<p>Found that hops that have been preserved by freezing can successfully be used to brew beer. All 26 brewing trials were successful over an 18-month period before the COVID-19 pandemic. Each trial tested a different propriety recipe developed by the brewer and were not owned by Dakota Hops. Additional brewing using frozen hops has begun post-COVID with Dakota Point Brewing, with successful early results.</p>	Objectives 1 and 4
3	<p>Our tasting panel (58 members) and all non-panel participants all concurred that they preferred beer brewed with frozen hops when the tasting panel convened during the first 18 months of the study to test the 26 separate batches. These were all single-batch beers. No one preferred beer brewed with kiln dried hops currently used by the brewing industry.</p> <p>Following the departure of the first partner brewer, a second brewer agreed to partner on new brewing trials, but none were conducted for tasting because of fermentation problems that impeded this brewer’s production efforts.</p> <p>The reason tasters preferred beer brewed with frozen hops:</p> <ol style="list-style-type: none"> <li>1. The beer was smoother, not bitter</li> <li>2. It had little or no aftertaste</li> <li>3. It enhanced other flavors that are often camouflaged when brewed with kiln dried hops</li> </ol>	Objectives 1 and 4, Outcome 2 Indicator 4.
4	<p>Different brewers led to different results. The brewer for the taste panel successfully used equal amounts of frozen and dried hops while the brewer for Dakota Point Brewing LLC, who contract brews for the study, sometime uses more frozen hops. The taste panel did not compare different brewers. All beer tasted by the taste</p>	Objective 1: Test/develop/refine recipes for brewing with frozen hops and freeze dried hops.

#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
	panel was brewed by the first partner brewer located in Spearfish, South Dakota. The brewer for the trials did not think they improved the flavor of the beer, although this may have just been a stylistic preference and the taste panel provided a much more positive assessment. The results do not reflect the second brewer involved in the study because of fermentation problems inhibiting his production. The brewer for Dakota Point joined post-COVID and sold beer directly to customers through the brewery's taproom. None of the beer brewed by Dakota Point was distributed to the taste panel, which had not convened for some time due to COVID.	
5	Trials were inconclusive because of lack of testing material resulting from fermentation problems during the brewing process for one of the brewing partners. Dakota Hops took hops to SDSU and Dr. Krishman performed the freeze-drying process as planned. Dakota Hops retrieved the hops and inserted them into the brewing process with the second brewer. Dakota Hops discovered that freeze drying took a lot of material (less efficient hop use than cryogenic freezing), and also found it to be a quite expensive and time-consuming process. The second brewer attempted to use the freeze-dried hops to brew beer, but that batch did not succeed.	Objective 2: Conduct brewing trials on freeze dried hops.
6	Results also inconclusive because the trial samples did not ferment properly. The taste panel did not have the opportunity to taste beer brewed by different brewers; all samples tested by the tasting panel were brewed by the first brewer involved in the study.	Objective 3: Compare brewing results of four hop harvests, 2015-2018.
7	All hop varieties (14) tested in our study showed an improvement in beer quality when compared to beer brewed with kiln dried hops.  Hop varieties included Cascade, Fuggle, Galena, centennial, hallertau, chinook, Idaho 7, Citra, Millennium, Mosaic, Amarillo, Mt. Hood, Brewers Gold, El Dorado.	Objective 4: Compare brewing results of additional hop varieties in addition to the cascade variety.

## CHALLENGES AND DEVELOPMENTS

*Provide any challenges to the completion of your project or any positive developments outside of the project's original intent that you experienced during this project. Also, provide the corrective actions you took to address these issues. If you did not attain an approved objectives, outcome(s), and/or indicator(s), provide an explanation in the Corrective Actions column.*

#	Challenge or Development	Corrective Action or Project Change
1	The COVID-19 Virus was the biggest thorn in our side because we couldn't complete the full three years of testing the original plan.	We were able, however, to partner up with Dakota Point Brewing, LLC in late December 2020 who is testing additional hop varieties that we obtained from commercial hop farmers in Idaho and Oregon. They also are test marketing the sample batches by marketing the beer through their tap room. We plan to build on this marketing concept with craft brewers and implement it through the recently approved SDSCGP Grants.
2	The COVID-19 virus and capacity and availability of the partner brewer resulted in diminished testing as originally intended for Objectives 1 and 4. The brewer's process has not been very precise and consistent which reduced the ability to do comparison testing between batches of beer or pinpoint the effects on different batches from different hops. The brewer performed all brewing and testing so Dakota Hops did not do the testing directly.	An attempt to return to these objectives would have to adapt to evolved brewing procedures at the partner brewer. The brewer has discretion over recipes and is essentially creating recipes through his regular brewing process. While the manner of testing has not been the same as originally proposed, and Dakota Hops is not doing the testing directly, the brewer is creating recipes (objective 1) and effectively testing the product through the brewery taproom (Objectives 3 and 4). This has led to increased brewing opportunities and the refining of brewing procedures, but without the precise year-over-year measurement originally anticipated. The project did evaluate use of hops that were several years old to see whether freezing can extend the useful brewing life of a hop past its prime and if freezing could help reduce the pace of hop quality deterioration associated with typically dried hops but incorporating these hops into brewed batches did not directly equate to the year-over-year hop harvest comparisons initially intended.
3	Fermenting problems inhibited the brewing trials (Objective 2) and subsequent comparison of brewing results across multiple hop harvests (Objective 3).	Pivoting to a partnership with Dakota Point helped the project carry on despite the interruption of COVID, loss of the first partner brewer, and the unsuccessful attempts by the second brewer. Dakota Point brewed some batches using Dakota Hops' frozen hops a few years prior before an internal personnel issue caused them to disengage. They wanted to start working again using frozen hops which had worked well the first time they partnered with Dakota Hops.
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## LESSONS LEARNED

*Provide recommendations or advice that others may use to improve their performance in implementing similar projects.*

New brewers partnering with an existing brewer have a distinct advantage in production, promotion and sales. Dakota Hops does not brew directly so cannot provide technical advice related to the actual brewing. Using a variety of hops and making small batches has been a good way to test a wide range of recipes, but the novel nature of the product means that standardized recipes do not exist and the product can be very dependent on personal tastes and brewer idiosyncrasies, which might not always translate into a consistent product for the purposes of trial batch comparisons. Engaging multiple partners is helpful because brewers

may have very specific preferred methods and tastes or may leave the project, and different markets want different products. Creating a consistent outlet for production and direct-to-customer marketing of the product has been a significant boost to the project.

**CONTINUATION AND DISSEMINATION OF RESULTS (IF APPLICABLE)**

*Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results.*

The hops study data will be disseminated through the QR Code printed on the label of the 16 oz cans we sell.

SDSU did not undertake any publication or promotion of the results since the beer freeze-dried at SDSU went into batches of beer that failed due to fermenter difficulties. In December of 2020 Dakota Point Brewing LLC started contract brewing for us using their equipment until the summer of 2022 when we purchased a four-barrel fermenter which greatly increased our brewing capacity. This was the only brewery partner involved at the end of the study. These brewing activities did not use the freeze-dried beer from Objective 2, and Dakota Point is selling the product directly to consumers rather than using it for tests/taste panels. Brewing trials and comparisons are therefore complete. Additionally, the successful brewing of both the first brewer and Dakota Point (third brewer) seemed to indicate that recipes specifically designed for frozen hops are unnecessary and that frozen hops can simply be substituted into a brewer’s regular recipes instead of dry hops. The major difference in the beer has proven to be the flavor, not the amount of hops used.

**BENEFICIARIES**

**Number of project beneficiaries:**.....Unknown, estimating hundreds.

**OUTCOME(S) AND INDICATOR(S)/SUB-INDICATOR(S)**

*Provide the results of the project outcome(s) and indicator(s) as approved in your application and project proposal. The results of the outcome(s) and indicator(s) will be used to evaluate the performance of the Program on a national level.*

**OUTCOME MEASURE(S)**

*Select the Outcome Measure(s) that were approved for your project.*

- Outcome 1:** Enhance the competitiveness of specialty crops through increased sales
- Outcome 2:** Enhance the competitiveness of specialty crops through increased consumption
- Outcome 3:** Enhance the competitiveness of specialty crops through increased access
- Outcome 4:** Enhance the competitiveness of specialty crops though greater capacity of sustainable practices of specialty crop production resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources
- Outcome 5:** Enhance the competitiveness of specialty crops through more sustainable, diverse, and resilient specialty crop systems
- Outcome 6:** Enhance the competitiveness of specialty crops through increasing the number of viable technologies to improve food safety
- Outcome 7:** Enhance the competitiveness of specialty crops through increased understanding of the ecology of threats to food safety from microbial and chemical sources
- Outcome 8:** Enhance the competitiveness of specialty crops through enhancing or improving the economy as a result of specialty crop development

**OUTCOME INDICATOR(S)**

*Provide the indicator approved for your project and the related quantifiable result. If you have multiple outcomes and/or indicators, repeat this for each outcome/indicator (add more rows as needed).*

#	Outcome and Indicator	Quantifiable Results
1	Outcome 2, Indicator 4.	The product – frozen hops – has been introduced to over 100 taste panel members and non-panel

	The related quantifiable result introduced to consumers will be specific hop varieties produced by mechanical freezing, cryogenic freezing and/or freeze-drying.	participants and they all overwhelmingly preferred beer brewed with frozen hops.  All hops tested were successful. These included Cascade, Fuggle, Galena, centennial, hallertau, chinook, Idaho 7, Citra, Millennium, Mosaic, Amarillo, Mt. Hood, Brewers Gold, El Dorado.
<b>2</b>		
<b>3</b>		
<b>4</b>		

## DATA COLLECTION

*Explain what data was collected, how it was collected, the evaluation methods used, and how the data was analyzed to derive the quantifiable indicator.*

Data was collected by Dakota Hops, LLC directly from taste panel members and others over 1.5 years. The Beer Judge Certification Program Sanctioned Competition Program Scoresheet was not used and instead the tasters voted on each tasting whether they preferred beer brewed with frozen hops or kiln dried hops. The tasters always (100%) voted in favor of frozen hops. There were not many certified judges in South Dakota and Dakota Hops determined they could meet the objective of evaluating whether beer could be brewed with frozen hops while using a simpler panel approach. The taste panel was composed largely of amateurs who voted on Option A vs Option B if multiple batches were offered for tasting and would discuss what the group liked about the beer (see Accomplishment 3).

The taste panel would meet on the last Saturday of the month. Sometimes the brewer would have multiple batches of beer brewed with frozen hops. Comparisons were made between beers brewed with the same variety of hops, although the hop ingredients were not necessarily from the same field or farmer. If the brewer offered a comparison between beer brewed with frozen hops and beer brewed with regular kiln-dried hops, the brewer would source his kiln-dried hops as normal. At times the taste panel convened and only tasted one single-batch beer brewed with frozen hops and the assessment focused more on evaluating the quality and the panelists' likes/dislikes.

## FEDERAL PROJECT EXPENDITURES

### EXPENDITURES

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds ONLY)
<b>Personnel</b>		
<b>Fringe Benefits</b>		
<b>Travel</b>	\$3,542.79	\$3,542.79
<b>Equipment</b>		
<b>Supplies</b>	\$4,072.21	\$4,072.21
<b>Contractual</b>	\$7,385.00	\$7,385.00
<b>Other</b>		
<b>Direct Costs Sub-Total</b>	\$15,000	\$15,000
<b>Indirect Costs</b>		
<b>Total Federal Costs</b>	\$15,000	\$15,000

\*Note: Agreed to an informal amendment with USDA to adjust the budget in 2022. Having spent \$8,859.69 as of the third annual report, USDA agreed with SD DANR and Dakota Hops to adjust the remaining \$6,140.79 to reorganize the remaining funds among the selected contractual, travel, and supplies categories.

**PROGRAM INCOME (IF APPLICABLE)**

Source/Nature (i.e., registration fees)	Amount Approved in Budget	Actual Amount Earned
1.	\$0	\$0
2.		
3.		
<b>Total Program Income Earned</b>		

<b>Use of Program Income</b>
<i>Describe how the earned program income was used to further the objectives of this project.</i>
Future income earned performing the activities outlined below will be reinvested under the 2021 Specialty Crop Block Grant.

**ADDITIONAL INFORMATION**

*Provide additional information available (i.e., publications, websites, photographs) that is not applicable to any of the prior sections.*

The hop study currently provides frozen hops, can labels and some equipment in exchange for beer used in our promotional efforts. That will change. Money in our 2021 grant allows us to pay the total cost for the brewery to brew our beer for market (e.g., grain, yeast, cans, etc.).
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