

From Traditional to Unique Wines – Strategies to Improve Montana’s Fermentation of Novel, Local Fruits

Montana State University- Western Agriculture Research Center

Cover Sheet

Organization Information			
Company/Organization Name	Montana State University- Western Agriculture Research Center		
Business/Organization Type (select one)	College/University		
Grant Project Contact	Zhuoyu Wang/Montana State University- Western Agriculture Research Center		
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Project Information			
Project Title (limited to <u>fifteen</u> words)	From Traditional to Unique Wines – Strategies to Improve Montana’s Fermentation of Novel, Local Fruits		
Award Request	\$389,054		
Project Start Date	09/30/2022	Project End Date	09/29/2025
Crop(s) benefitting from project	Grape, Apple, Haskap, Blackcurrant, and other fruits		
Will project benefit beginning farmers?*	Yes	Will project benefit socially disadvantaged farmers?***	Yes
Is this a multi-state project?	No	List partnering state(s)	Montana State University- Western Agriculture Research Center
Does project include market adaptations for COVID-19?	No	If yes, explanation	

***Beginning farmers** - individuals or entities who have not operated a farm for more than 10 years and substantially participates in the operation.

****Socially disadvantaged farmers** - means a farmer who is a member of a socially disadvantaged group. A “Socially Disadvantaged Group” is a group whose members have been subject to discrimination on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program

Narrative

Abstract

Include a project summary of 250 words or less, suitable for dissemination to the public. It should include:

1. *The name of the applicant organization*
2. *A concise outline the project's outcome(s), and*
3. *A description of the general tasks to be completed during the project period to fulfill reach outcomes.*

Fermentation adds value to specialty crops, increasing profitability of growers and processors. With 28 wineries and cideries and almost 150 vineyards, orchards, berry farms, the cider and wine industry in Montana is poised to profit from value-added and agritourism-based specialty crop production. For the success of the fermented specialty crop industry, these beverages must optimize both flavor and profitability. For many of these new cold-hardy varieties there is a clearly defined need for research to identify appropriate methods for production of desirable and profitable fermented products. Montana State University will fill this need by pioneering fermentation processes for fruit wines, grape wines, and apple ciders. This project will also evaluate novel products from winery waste streams to take advantage of pomace that would otherwise be disposed of. Knowledge for northern wine and cider fermentation will be developed and shared via booklets, website resources, and workshops at regional conferences; these data will be combined with sensory evaluation to identify best practices. By improving fermentation methods and profitability, this study will empower long-term financial success for our farmers, wineries, and cideries.

Project Purpose

1. What is the specific issue, problem or need?

- What is the problem or need that you are trying to address?
- Why is the project important and timely?
- What is the importance to specialty crop stakeholders?

This project seeks to improve the quality and value of fermented products made from cold-hardy fruit with expanding cultivation in the state of Montana (grapes, apples, haskaps, currants, and more). This project is necessary due to the recent growth of the Montana fruit production, wine, and cider industries. Producers demand assistance in optimizing means of processing fruits to create appealing, commercial, cost-effective fermented products. This project is important to specialty crop stakeholders including fruit producers (orchards, vineyards, and berry farms) and post-harvest purchasers and processors because it will drive new innovations in quality of wines and ciders, thus ensuring when consumers taste Montana fruit products they are left with a positive and lasting impression.

This project aims to develop research-based solutions to local producers' questions. Major challenges to optimizing quality and quantity of cold-hardy fruit wine and cider include tannin and phenolic levels (compounds dictating mouthfeel and astringency), high-acid levels, and accessibility of local fruit in sufficient quantity.

Montana's variable climate has resulted in wide swings (booms and busts) in the availability of fruit crops for processors. One method to increase production from minimal fruit involves creating formula wines by adding water to the pulp remaining after crushing fruits, which is normally treated as waste. The resulting products, piquette and ciderkin can be made cheaply, quickly, and with delightfully refreshing flavor and taste.

Montana's climate is poised to produce high-quality, novel fruit crops (haskaps, currants, and more). In-order to ensure the producers and farmers of these high-value, specialty crops obtain optimal return on investment, this project aims to explore, develop, and educate producers on fermentative techniques leading to improved mouthfeel and increased profitability.

Grapes:

Northern cool-climate wine frequently contains excessive acid due to the short season and low temperatures. Wine production from cold-hardy grapes requires deacidification with yeast, bacteria, and chemical processes (Lasik et al., 2013). The deacidification regimens and recipes in traditional wine matrices usually fail to modify cold-hardy grapes in an appropriate manner. Beyond this, northern cold-hardy grapes are consistently low in total tannins, making for red wines with minimal mouthfeel or astringency. Use of exogenous tannin and improved maceration techniques can help overcome these deficiencies.

Apples:

Northern apple farmers and cider producers are confronted with many issues and risks (Wicklund et al., 2020). Without research discovering suitable methods for cider fermentation of local cultivars and heritage cultivars, local cider producers still use standard methods and imported cider apples or dessert apples for cider making. Building towards promotion of the Montana Heritage Orchard Program, distinguished heirloom apple cider varieties need to be studied, characterized, and tasted to increase orchard adoption. Various methods for improving our local wine and cider include, but are not limited to, fruit preparation, yeast selection, enzyme application, and pomace reuse.

Specialty Small-Fruit:

Montana growers, wineries, and cideries are eager to incorporate the unique MT-grown berries and small fruits into their products. Fruit wines are the top selling wines at several wineries in the region, including Tongue River Winery in Miles City. Fruit wines produced from Montana adapted fruits have almost no research-based knowledge to support current formulas. Increasing customer preference toward fermented superfruits increases the market impact of our specialty crops overall. Fermented products will take our specialty crops to new niches and bring our novel crops and flavors to a broader, national market. Fruit wines are a critical market component for northern US wineries, due in-part to improved bioactive compounds, unique sensory properties, and enhanced nutritional value. As an effective preservation method, fruit wines also serve to improve fruit transportation and distribution by largely reducing post-harvest and production losses (Swami et al., 2014).

Overall:

To encourage judicious use of fruits towards Montana fruit wines, grape wines, and ciders, research and educational workshops are necessary to inform wineries and cideries of techniques to improve extraction procedures and refine processes. Unique to fruit wines, most fruits are frozen prior to processing for long-term storage until a winery purchase. Growers and producers alike demand to know what techniques can be used to maximize flavor and color of their products. Our goal with specialty fruits is to dig into their potential beverage applications, broaden their impact in the state and region, and increase profits for our farmers and producers through education and outreach.

2. What are the objectives of the project? Provide a listing of the objectives that this project hopes to achieve

Objective Name	Objective Description
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<p>1) Novel fermented recipe development</p>	<p>Improvement of traditional wine and cider fermentation methods will be coupled with the development of novel fruit wines using Montana grown specialty fruits, such as haskap and blackcurrant.</p> <p>Sub-Objective 1: Fruit-Wine Recipe Formulation In-order to optimize fruit wine formulations, various dilution and chaptalization methods will be evaluated with lab analysis and small-scale tasting panels before scaling-up for producer sensory analysis. These methods will be employed in conjunction with variety and species evaluations to improve the overall capacity for economic production of different fruit wines.</p> <p>Sub-Objective 2: Cider Improvement and Grape Wine Improvement Grape growers, wine makers, cider growers, and fermenters are interested in yeast strain selection, skin contact duration, and other fermentative treatments impacting cider and wine quality. These will be explored in laboratory scale fermentations to identify cultivar and management practices that improve fermented cider and wine quality.</p> <p>Sub-Objective 3: Waste Stream Valorization Through addition of water to wine and cider wastes, low alcohol products will be produced with capacity for sales as sparkling water and wine-like products. Piquettes and ciderkins will be produced from pomace residue (skins, seeds, pulp) at the end of winemaking processes. These products will be introduced to the community of stakeholders with insight on flavor and process optimization.</p>
<p>2) Winery and Cidery Education</p>	<p>Methodologies for specialty crop fermentation will be shared to increase the knowledge of farmers, wineries and cideries. Our team will increase producer and processor knowledge-base and novel technique adoption through outreach including workshops, extension guides, and sensory presentations. Education will inform processors of chemical outcomes while allowing them to taste different products resulting from techniques evaluated. To spur adoption, industry experimentation will be encouraged for subsequent discussion-based evaluations of methodologies.</p>
<p>3) Increase profits of fermented products</p>	<p>By increasing the quality and quantities of fermented traditional and novel products longterm profitability will be improved for our local economy, especially for farmers, wineries and cideries. Yields of fermented products will be calculated along with price estimates for inputs. This will improve business decision-making for farmers and processors seeking to optimize price points on fruit and products. Evaluation of valorization of waste stream</p>

	products (pomace, seeds) may lead to added value and/or product lines, stabilizing expanded production of final products and market to help the berry, grape, and orchard industries as they seek to expand plantings and field productivity.
4)	
5)	

Potential Impact

1. **Who are the beneficiaries of the project?** Be as specific as possible, describe the population affected and where they are located. Use statistics to describe the target population.

The project will benefit over 25 berry growers, 50 vineyards, 70 orchards, the current 19 wineries and 9 cideries in Montana State, and the whole northern US specialty crop growers and producers.

2. **How many beneficiaries will be impacted?** The answer to this must include a number.

We estimate that in Montana 145 fruit growers and 28 wineries and cideries will benefit from this project.

3. **How will the beneficiaries be impacted by the project?** Be specific and refer to the target population. Discuss their current condition and how the activities performed will improve that condition.

This project will benefit the specialty crop industry of Montana through

- (1) food product development: cideries and wineries will benefit from research-based product development that will improve the product quality and profitability; fruit growers will benefit from increased demand and markets for their products from cideries and wineries.
- (2) educational benefits targeting improving industry knowledge on research topics and overall production practices.
- (3) economic benefits stemming from increased quality of fermented products and/or reduced costs of production.

Outreach

Describe how you will share the results of the project with specialty crop growers and other interested specialty crop stakeholders.

Workshops: Specialty crop fermentation methods will be demonstrated to farmers through workshops at the Western Agricultural Research Center, and regional stakeholder meetings.

Conferences: Research methods and recipes will be shared at the Montana Berry Growers Association and the Montana Grape and Wine Association annual meetings and workshops. This will be an opportunity for producers to taste and identify production methods that fit their product goals.

Publications: Based on the fermentation product method and analysis, approximately 3 scientific publications will be generated and shared through journals. Project objectives and outcomes will also be shared on the WARC website and extension publications targeting cider and wine makers in MT.

Sensory Outreach: Fermented projects will be tasted and evaluated by selected panelists. Feedback and suggestions will be collected afterwards.

Local website/ newspaper: applicable methods for both specialty crop fermentation will be shared, highlighting novel techniques and producer adoption of new techniques.

External Project Support

Describe the individuals and organizations that support the nature of the support they are providing.

Montana Berry Growers Association and the Montana Grape and Wine Association will host an annual conference and convention each year in Montana, at which the results of this project will be presented to growers.
Multiple farmers and specialty crop processors will partner for sensory evaluation and for product development feedback.

Eligibility

By marking the box below, I confirm that this project enhances the competitiveness of specialty crops in accordance with and defined by [7 U.S.C. 1621](#). Further information regarding the definition of a specialty crop can be found at www.ams.usda.gov/services/grants/scbgp.

Yes	X
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Previous Efforts

Does the project build on a previously funded SCBG project?

Yes

If YES,

1. Describe how the project differs from and builds on the previous project.

This project builds on a previous, SCBG-funded project entitled, Supporting the growth of Montana vineyards and wineries through research and outreach. Between 2017 and 2020, one of the objectives of this project was to identify the types and varieties of cold-hardy berries for better wine making. The current proposed project builds on this project by optimizing recipe development for the most preferred fruit wines, haskap and blackcurrant.

2. Provide a summary (3 to 5 sentences) of the outcomes of the previous project(s).

Single variety wines with consistent recipes were made from nearly 45 varieties of haskaps, aronia, blackcurrant, redcurrant, Saskatoon, and dwarf sour cherry. Based on small-scale flavor evaluations, redcurrant and Saskatoon wines were not preferred, a final test of 28 single variety wines were made and evaluated by a panel of 70 stakeholders. Overall, we found that most cultivars yielded wine ranging from acceptable to high-quality, but a few cultivars were significantly more or less preferred by most tasters. Results were shared on MSU-WARC's website and several grower meetings and workshops.

3. What was learned from implementing this project, including potential improvements?

The previous project was the first wine-making research done at Montana State University. We learned much about the logistical challenges of small-batch wine/cider making and sensory evaluation. The main lesson for the evaluation is that less is better. The quality of sensory evaluation per session was more effective with limited types (less than 7) of wine.

4. How are the lessons-learned being incorporated to make the ongoing project more effective and successful at meeting goals and outcomes?

Our equipment, knowledge, and facilities for wine/cider research have improved at MSU-WARC and we have established relationships with commercial wineries/cideries to produce research wines in their facilities. While the current wine analysis equipment could be improved, we have made consistent and quality research wines in our fermentation laboratory. The number of samples sent for a single sensory evaluation (aroma and taste test) will be limited to less than 7.

5. Describe the likelihood of your efforts becoming self-sustaining and not indefinitely dependent on grant funds.

University research for specialty crop growers and processors will always rely on grant funding.

Support from Other Federal or State Grant Programs

Did you submit this project to a Federal or State grant program other than the SCBGP for funding and/or is a Federal or State grant program other than the SCBGP funding the project currently?

No

If YES,

- Identify which Federal and/or State grant program

- Describe how the SCBGP project differs from or supplements the other grant program(s) efforts.

Project Funding

Provide the following information in this section:

Could the outcomes of this project be accomplished with a reduced budget?

Yes, we would accept a reduced amount, with corresponding reductions in outcomes.

If NO, you are indicating that the project could not be accomplished with a reduced budget (i.e. the funding decision must be “all or nothing”).

If YES, indicate which areas of the project could be cut and any resulting changes in project outcomes.

Explain:	<p>The personnel funded on this project are essential to research accomplishment, outreach, and dissemination to the specialty crop community of Montana.</p> <p>The project could justifiably reduce the expenditures towards Equipment Item, the Lyza FTIR Wine Analyzer system, and still accomplish the major objectives of the project for characterizing final wine and cider products. However, this would lead to a drastic reduction in the depth of results and interpretation. The FTIR Wine Analyzer yields multiple results (in-ferment and post-ferment) that are essential to reporting to growers on the fermentation dynamics and final wine product. To compensate for the lack of FTIR Wine Analyzer system, this project would be forced to rely solely on external laboratory testing at a rate of \$207/ sample for basic composition analysis (\$207/ sample Basic Analysis of Fermentation In-Process/ or Post-Process= \$35/sample Organic Acids + \$35/sample Yeast Assimilable Nitrogen + \$25/ sample Ethanol + \$15/ sample Titratable Acidity + \$12/sample pH + \$30/sample Residual Sugar + \$25/ sample Acetic Acid + \$25/ Sample Lactic Acid+ \$5/sample Shipping, Handling, Dry-Ice).</p> <p>As a result, the FTIR Wine Analyzer would project to be a more judicious investment, more than paying for itself after just over 200 samples were processed. For example, a traditional fermentation experiment requires a minimum of once daily sampling to gain insight into fermentative processes; given six treatments and three replicates per treatment, a single-year grape wine experiment lasting more than 12 days would require external sampling costs that exceed the price of this equipment (216 samples for a small, single-year experiment).</p> <p>With an analytical timeline of ~1 minute/ sample, this tool will allow for rapid turnaround and high-definition characterization of fermentation dynamics to identify fermentative treatments' interacting results, thus more thoroughly communicating to producer's the on-going fermentative parameters dictating evolution of final wine composition.</p> <p>For these reasons, this equipment will justifiably improve the capacity for the Western Agricultural Research Center to address grower and processor questions proactively and prodigiously regarding fruit must (juice at harvest), fermentation, and final products while ultimately minimizing research expenditures related to this project and further fermentative based investigations in the future.</p>
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Citations (Optional)

A list of citations may be added to the application but is strictly optional.

<p>Lasik M (2013) The application of malolactic fermentation process to create good-quality grape wine produced in cool-climate countries: a review. <i>European Food Research Technology</i> 237:843–850</p> <p>Mordor Intelligence (2021) United States blueberry market-growth, trends, Covid-19 impact, and forecasts (2022-2027)</p> <p>Swami SB, Thakor NJ, Divate AD (2014) Fruit wine production: a review. <i>Journal of Food Research and Technology</i>. 2:93-100</p> <p>Wicklund T, Skottheim E, Remberg SF (2020) Various factors affect product properties in apple cider production. <i>International Journal of Food Studies</i>. 9: SI84–SI96</p>
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