Form B: Full Proposal Template

(Submit final as a PDF described in **Full Proposal Preparation Instructions** above).

Form B: IGEM-HERC Full Proposal Cover Sheet

Idaho State Board of Education

PROPOSAL NUMBER: (to be assigned by HERC)	TOTAL AMOUNT REQUESTED: $980,300 (Y1=$336,500, Y2=$372,800, Y3=$271,000)
Proposal Track (select one): Commercialization	

TITLE OF PROPOSED PROJECT: Valorizing Potato Juice and Oat Pulp to Food Ingredients
SPECIFIC PROJECT FOCUS: The purpose of this proposal is to upcycle potato and oat byproducts into higher value consumer ingredients and food products. We propose to create a new business operation in Glenns Ferry, ID, where we will convert low value (i.e., below-grade, undersized, bruised, surplus, etc.) potatoes into starch and protein for consumer products. We will generate revenue from sales of food-grade potato starch and protein ingredients.

7/1/2025 PROJECT START DATE:	6/30/2028 PROJECT END DATE:

NAME OF INSTITUTION: Boise State University	DEPARTMENT: Chemistry-Biochemistry

ADDRESS:	Boise State University Office of Sponsored Programs 1910 University Drive Boise, ID 83725-1135

E-MAIL ADDRESS:	osp@boisestate.edu	PHONE NUMBER:	208-426-4420

NAME:	TITLE:	SIGNATURE:

PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR	Owen McDougal	owenmcdougal@boisestate.edu	Owen McDougal Owen McDougal (02/25/2025 14:11 MST)
CO-PRINCIPAL INVESTIGATOR	n/a	n/a	n/a

NAME OF PARTNERING COMPANY:	1. Genesis Organics 2. Idaho Potato Products 3. Idaho Potato Products 4. Genesis Organics 5. Food Physics 6. Gibby Group	COMPANY REPRESENTATIVE NAME:	1. Don McFarland 2. Tom Gillette 3. Mauricio Salamanca 4. Manny Flores 5. Kalen McKenzie 6. Monte Quast

SIGNATURE:

LOS signed in Appendix D

Authorized Organizational Representative	NAME: Ella Christiansen Assistant Director, Pre-Award	SIGNATURE:

1. **Idaho Public Institution: Boise State University**
2. **Project Title: *Valorizing Potato Juice and Oat Pulp to Food Ingredients***
3. **Name and Institution of PI: Owen M. McDougal and Boise State University**
4. **Total Amount Requests: $980,800 (Yr. 1: $337,000; Yr. 2: $372,800; Yr. 3: $271,000)**
5. **Significance of Project and Project Objectives**

Summary

The purpose of this proposal is to upcycle potato and oat byproducts into higher value consumer ingredients and food products. We propose to create a new business operation in Glenns Ferry, ID, where we will convert low value (i.e., below-grade, undersized, bruised, surplus, etc.) potatoes into starch and protein for consumer products. We will generate revenue from sales of food-grade potato starch and protein ingredients. Boise State University (BSU) will develop an innovative, proprietary method to employ pulsed electric field (PEF) technology to maximize the recovery of potato starch, protein, and fiber. Idaho Potato Products (IPP) is a seed stage startup company that will serve as our primary business partner to convert potatoes into ingredients for B2B2C sales, and new product development of potato protein containing beverages and alternative meat products for B2C sales. IPP will use the potato protein as an ingredient in their potato beverage, Papa Latte. We will also recover pulp from Chobani's oat milk processing, and combine it with potato protein through twin screw extrusion, to convert low value animal feed into high value human food. The upcycling of surplus potatoes and oat pulp co-product into ingredients and consumer products will utilize millions of pounds of waste, provide cost savings for upstream processors, and generate $4M/yr. in new revenue for Idaho through the advancement of IPP into business expansion stage by production scale annual processing of 16M lbs. of potatoes into 5M lbs. of starch and 1M lbs. of protein ingredients, creating 21 new jobs by 06/2028.

Objectives

(1) Establish a new potato starch and protein operation in Glenns Ferry, Idaho (B2B2C)

(2) Commercialize potato starch and protein ingredients for use in consumer products (B2B2C)

(3) Generate consumer products containing potato ingredients through IPP (B2C)

Significance and Viability

Potato Background: Idaho produces more potatoes than any other state in the country, with 135M cwt (where M = million and cwt = hundredweight) produced in 2024. These potatoes are processed into frozen, refrigerated, and dehydrated products, in addition to potato chips and French fries. During the COVID-19 pandemic, potato starch became popular as a coating for French fries to retain crispiness after frying.[1] This attribute of potato starch was particularly advantageous for takeout food businesses to maintain fry quality, texture, and crispiness during transportation. The Stealth Fry product has a potato starch coating that keeps fries hotter and crispier for more than twice as long as traditional fries. Potato starch is used as a thickener, coating, and ingredient in batters for food products including fried chicken, onion rings, fish, etc.

Ingredion is an $8B/yr. company in net sales that is the largest supplier of United States (US) made specialty potato starches; one of their five US potato plants is in Idaho Falls. Ingredion sells on the order of 150M lbs. of potato starch in the US each year, of which 40-42M lbs. comes from Idaho. They seek to increase domestically sourced potato starch by an additional 50M lbs. over the next 5-yrs. Idaho is well-positioned for growth in the potato starch ingredient market. The conversion of low-grade, small-sized, cull, and surplus potatoes into starch is a viable revenue stream for growers and processors. The side-stream of potato starch production is a juice that contains potato protein. This protein has a high biological value (BV), that is comparable to eggs,

which means the protein is incorporated into muscles in the human body readily through diet.[2] Furthermore, potato protein contains all essential amino acids and is high in branched-chain amino acids, comparable to whey protein, as an ingredient for sports nutrition and exercise recovery products.[3] The protein digestibility-corrected amino acid score (PDCAAS) for potato protein is 0.92-1.00, which is comparable to soy and pea protein. In 2023, Glanbia Nutritionals' made $3.6B, and income from Glanbia PLC was $5.4B. Glanbia and Ingredion are market leaders with customer demand for the potato protein ingredient we propose to supply. Discussions between PI McDougal, Gillette of IPP, Nichols and Wu of Ingredion, and Ward of Glanbia Nutritionals have generated interest for IPP produced starch and protein ingredient outlets in Idaho to meet growing consumer demand.

Problem 1 – Potato Juice: Due to low concentration and complex separation methods required to recover potato protein, this valuable byproduct of potato processing is often discarded, contributing to a substantial waste management expense. We propose to leverage a prior IGEM Commerce award that afforded the equipment to separate and recover both starch and protein from potatoes grown by Genesis Organics. We will develop an innovative protocol to maximize recovery of starch and protein by pre-treatment of potatoes with pulsed electric field technology. We will use a refined version of the SiccaDania method to separate starch and fiber, and a modification of the protocol proposed by Waglay et al.,[4] that uses ammonium sulfate precipitation and successive ultra- and nanofiltration steps to maximize protein recovery. The process by which we maximize starch and protein recovery is expected to generate intellectual property leading to a patent, and results from our preliminary work have been used to calculate a return on investment (ROI) for the business plan that is detailed later in this proposal.

Oat Background: The Chobani Greek yogurt facility in Twin Falls, ID produces a variety of oat products including, oat milk, creamer, protein shakes, and others. This single location generates on the order of 48 tons/wk. of oat pulp byproduct, which is currently disposed of by the Carne Group, a subsidiary of the Gibby Group, for use as low value animal feed.

Problem 2 – Oat Pulp Waste: Oats are rich in protein, dietary fiber, vitamins and minerals, and phytochemicals.[5] The byproduct of oat milk is an insoluble pulp with low levels of protein, high amounts of β-glucan rich dietary fiber, and phenolic compounds with bioactivity as antioxidants, antimicrobials, anti-inflammatory, etc.[6] We will upcycle oat pulp by extrusion to make alternative meat products with the texture and consistency of pulled pork, shredded chicken, or ground beef.

Viability of Problems 1&2: Over the past 2-yrs., Ingredion has sought to increase the potato starch they obtain from US operations by 50M lbs. by 2030, with a focused interest in Idaho-based businesses. In response, members of our team have met with Ingredion and identified a viable path to pursue starch using small-sized, low-grade, and surplus potatoes that are discarded by our partner Genesis Organics and other Magic Valley, ID growers and processors. McFarland and Flores own Genesis Organics, and they are co-owners of IPP with Gillette and Salamanca. McFarland will provide the infrastructure, potato washing and sorting equipment, with an estimated value of $2M to establish the starch and protein operation in Glenns Ferry, in conjunction with the existing fresh pack potato operation run by Genesis Organics. Gillette and the other members of IPP will purchase the processing equipment for the conversion of potatoes to starch and protein at an estimated in-kind match of $2M. PI McDougal will conduct the research essential to efficiently recover protein from the potato juice co-product created during starch production, and conduct functional and physical property quality assessment of starch and protein ingredients for human grade product valuation in the Food and Dairy Innovation Center (FDIC) at BSU. The starch ingredient will be independently evaluated by Wu and Nichols of Ingredion and the potato protein ingredient will be assessed for consumer product utilization (i.e., beverages, ready-to-mix (RTM) drink powders, bars, and supplements) in collaboration with Ward, Chief Innovation Officer, at Glanbia Nutritionals. This is a critical go/no-go step for the project. By

06/2026, the quality of starch and protein must be deemed consumer grade to warrant further investment. Simultaneous to the establishment of starch and protein ingredient production, we will obtain oat pulp byproduct from Chobani, through our partnership with Quast, CEO of the Gibby Group. PI McDougal will conduct pilot scale production of extruded oat-based alternative meat products using a Brabender pilot-scale TWINLAB F 20/40 extruder that belongs to the FDIC at BSU. The extruder will be located in the food grade lab at Boise-based Food Physics (FP) to optimize the production of extruded oat-based alternative meat products. FP has provided an in-kind match of $101,000/yr. in office, lab, and warehouse space for this project. The facilities, equipment, and know-how are available for this team to process tons of oat pulp and potatoes into food ingredients and products within the timeframe of this IGEM HERC award.

6. Specific Project Plan and Timeline

The project plan for this 3-yr. IGEM HERC Commercialization track proposal (07/2025 – 06/2028) includes two milestones per year, where Milestone 1 is to acquire and set up commercial processing equipment in Glenns Ferry, ID; Milestone 2 is to produce potato starch and protein in the BSU FDIC for functional and physical property evaluation; Milestone 3 is to provide ingredients to Ingredion and Glanbia Nutritionals for evaluation, and conduct oat pulp extrusion trials at FP; Milestone 4 is to produce potato starch ingredient for sales to generate revenue, protein formulation assessment for consumer products, and operation expansion by IPP; Milestone 5 is to commercialize starch and protein ingredients, and perform a ROI assessment; and Milestone 6 is to market and sell protein containing beverages and extruded oat-based alternative meat products to distributors and consumers. ***Metrics for Success:*** Yr. 1 – go/no-go = kg quantities of consumer quality starch and protein by 06/2026, Yr. 2 – go/no go = generate $250,000 in ingredient sales by 06/2027, and Yr. 3 – revenue to reach $4M/yr. by 06/2028.

Technology Readiness Level (TRL) continuum: The current state of the proposed project is between development (Level 6) and deployment (Level 7). The research phase of this project (TRL 1-3) was conducted as the focus of a 2023 IGEM Commerce project, "*Functional Food Ingredient – Potato Protein Concentrate*". PI McDougal partnered with IPP, i.e., McFarland, Flores, Gillette, and Salamanca to process potatoes into potato protein for extrusion at Washington State University (WSU), which completed the experimental proof of concept (Level 3). Protein ingredient and extruded product evaluation for biological value were performed in the FDIC at BSU (Technology validation in the lab; Level 4). PI McDougal has secured funds through a National Science Foundation grant focused on food and nutrition security, to purchase a Brabender pilot-scale TWINLAB F 20/40 extruder similar to the one accessed at WSU. The extruder will be housed in the food grade lab at FP for use by McDougal's team to develop the oat-based meat alternative products. The potato protein for food product development aligns with the first aim of this proposal, which is to establish a starch and protein processing operation in Glenns Ferry, constituting the expansion stage for IPP. The processing equipment, including a potato washer, rasper, centrifuge, hydrocyclone, vacuum filter, and flash dryer will be obtained by McFarland and IPP for an in-kind contribution on the order of $2M, and set up for operation by 06/2026. The potato juice side-stream of the starch operation will provide a feedstock from which PI McDougal and his team at the BSU FDIC will extract and purify potato protein. The starch and protein will be evaluated for functional properties, and assessed for compatibility in the formulation of consumer products (Level 5). The starch and protein ingredients will be sold at a market value of $0.65/lb. and $9/lb., respectively to generate revenue by 06/2027, constituting the TRL development stages from 4 to 6. Lastly, by the third year of IGEM HERC support, potato protein ingredient will be used in the formulation of Papa Latte, and the extruded oat alternative meat products (Level 7). ***The goal of this project is to produce potato starch, potato protein, and new consumer products using Idaho grown potatoes that are processed at IPP in Glenns Ferry, ID.*** Work that has been done for TRL 1-3 and 4-6 regarding oat extrusion for consumer products was conducted by FP, with their collaborators at the German Institute of Food Technology (a.k.a. DIL) in Quakenbrück

(Level 6). Salamanca and Gillette have formulated their Papa Latte beverage using potato varieties grown by McFarland and Flores (Level 6). Additional consumer product opportunities will be explored in partnership with Ward at Glanbia Nutritionals. For a comprehensive list of partner organizations, people, their roles, and contributions, see **Table 1**.

Table 1. Partnerships, roles, responsibilities, and contributions to support project activities

Organization	Person†/position	Role	Contribution*
Boise State Univ.	Owen McDougal – FDIC Director Caleb Renshaw – PhD student Research Scholar – PhD (new) BSU Accounting Services	PI – Science lead Student scientist Staff scientist Accounting	Resources & personnel Ingredient process & assess Starch, protein, extrusion Manage grant budget
Genesis Organics	Don McFarland† – Owner Manny Flores – Co-owner	Business partner Business operations	Potato supply, operation infra-structure, equipment, est. $2M
Idaho Potato Products	Tom Gillette† – Builder/businessman Mauricio Salamanca - Advisor	Potato starch and protein expansion	$2M for processing equipment and industrial extruder
Food Physics	Kalen McKenzie† – GM/owner	Extruder environment	$101K/yr. food lab access
Gibby Group	Monte Quast† – CEO	Business partner	Oat pulp supplier
Ingredion	John Wu – Starch Div. Head NA Dustin Nichols† –Mgr. Potato Supply	Starch and protein ingredient evaluation	Testing to align starch and protein to consumer products
Glanbia	Loren Ward† – Chief Innovation Officer	Potato protein product evaluation	Testing of starch, protein and fiber for consumer products
CERES	Sara Dorland - Economist	Techno-economic analysis	Cost basis assessment of operations and profitability
Studio/Blu	Catherine Cantley – Director	Sensory evaluation by consumer panel	Ingredient and consumer product market fit

*Contribution of expertise, material support, and in-kind matching funds for this project

†Signed letter of support in Appendix D

PROJECT PLAN

Our project plan includes three steps: (Yr. 1) establish a new potato starch and protein processing operation in Glenns Ferry, Idaho, (Yr. 2) commercialize potato starch and protein ingredients for use in consumer products, and (Yr. 3) generate consumer products containing potato ingredients through IPP. Our metrics for success are: Yr. 1 (milestones 1&2) produce kg quantities of consumer grade potato starch and protein ingredient, Yr. 2 (milestones 3&4) generate $250,000 in revenue from ingredient sales, and Yr. 3 (milestones 5&6) achieve the operational capacity to cover production costs (est. $4M/yr.). By Yr. 5, we expect to be running a profitable business with annual revenue on the order of $7M/yr. An overview of the steps utilized in the FDIC at BSU for the conversion of potatoes to starch and protein is provided in **Figure 1**, where each piece of equipment that is displayed has already been purchased through investment by IGEM HERC and IGEM Commerce programs, with the exception of the flash dryer. The goal of this IGEM HERC project is to transition from pilot scale research on 100 lbs. of potatoes per batch at BSU to industrial scale processing of 2,000 lbs./hr. potatoes for an annual processing capacity of 16M lbs./yr., or $4M/yr. revenue at IPP by 06/2028.

Starch processing – PI McDougal has worked with Nichols at Ingredion over the past 2-yrs., using the SiccaDania industrial method for starch recovery, to evaluate Idaho-grown varieties of potatoes for starch content. This work has been performed in the BSU FDIC and the equipment, infrastructure, and personnel are available for the conversion of 100 lbs./batch of potatoes to starch. Gillette of IPP has further discussed the potential to set up a starch processing operation to be co-located in Glenns Ferry at the Genesis Organics fresh pack site. The potatoes that will be processed into starch will come from McFarland and Flores' fresh pack operation, and neighboring growers and processors that have access to an abundance of surplus potatoes.

Genesis Organics produces 4M lbs./yr. of deformed, bruised, undersized and surplus potatoes, equating to loses on the order of $400,000. Within 3-yrs., IPP will process 16M lbs./yr. of potatoes to generate 5M lbs. of starch with a market value of $3.1M, based on a price of $0.65/lb. Interviews with Trinity Frozen Foods identified their cost for potato starch at $0.67/lb. providing confidence that the $0.65/lb. estimate for starch is reasonable.

Potato protein upcycling – The byproduct of potato starch processing is potato juice which contains protein. The protein will be recovered from potato juice by centrifugation, vacuum filtration (125 µm sieve), ammonium sulfate precipitation, and filtration (i.e., ultra- and nano-filtration) (**Figure 1**). PI McDougal will evaluate the optimal method to obtain potato protein from the juice utilizing the resources available in the FDIC at BSU. Within 3-yrs., IPP will generate $864,000/yr. by producing 96,000 lbs. of potato protein ingredient for consumer products at a market value on the order of $9/lb., which is competitive with soy, pea, and whey. A comparable potato protein is available through AVEBE for $9.27 to $11/lb. Our protein ingredient will be evaluated for functional properties (i.e., foaming, emulsification, texture, odor, taste, solubility, etc.) in partnership with Ward at Glanbia Nutritionals to determine the best use of the ingredient in consumer products (i.e., drinks, RTM, bars, supplements, etc.).

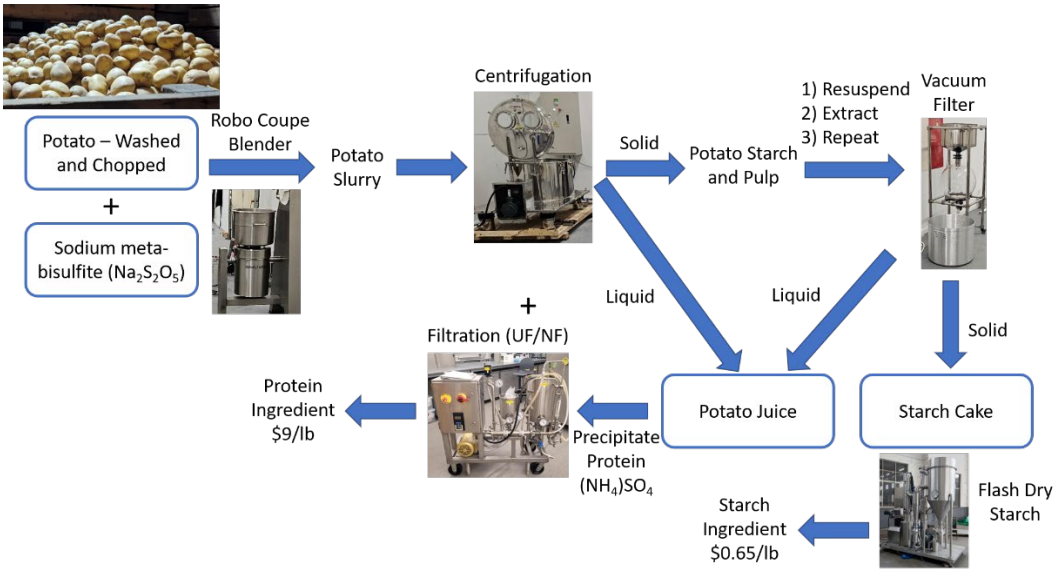


Figure 1. Overview of potato processing in the FDIC at BSU. Batches (100 lbs.) of potatoes are converted into starch and protein ingredients to evaluate product quality, process efficiency, market value in consumer products, and estimate return on investment for scaleup.

New product development – The potato protein ingredient will be used in consumer products. Salamanca of IPP inspired the formulation of Papa Latte, a potato-based beverage. The challenge encountered during product development was a suitable protein to use in the formulation. Pea proteins from across the US and Canada were evaluated with less than desirable organoleptic properties (i.e., taste, odor, texture, etc.). It is our intent to utilize potato protein in the Idaho-produced Papa Latte product. In addition, we seek to develop new products from Chobani's oat pulp byproduct that include extruded oat-based meat alternatives. The potato protein will be combined with oat pulp and seasonings, as input into a twin-screw extruder to obtain the desired product texture for shredded chicken, pulled pork, and ground beef plant-based products. Cantley is a Food Scientist that will conduct consumer testing panels, each panel enlists fifty participants across the market demographic, to advise refinement and marketability of consumer products.

7. Potential Economic Impact

The potato industry in Idaho is internationally renowned for its quality and value. We propose to leverage agriculture technologies for food waste mitigation to generate revenue for growers and processors from their low grade and surplus potatoes. PI McDougal has leveraged the infrastructure, resources, and trusted collaborative relationships derived from the BSU FDIC, to assemble representatives from the right companies to drive economic returns for Idaho (see **Table 1**). McFarland and Flores are the principal suppliers of organic potatoes across the Pacific Northwest. To amplify economic return and prosperity for Genesis Organics, additional outlets for potatoes beyond the fresh pack market are essential. The project we propose will utilize infrastructure at the Genesis Organics potato processing facility to set up the IPP starch recovery operation. The economics of starch is difficult because the price of dried potato starch to the B2B2C market can be as low as $0.65/lb. In order for starch processing to be sustainable in the US, high quality protein for human consumption must also be recovered. Potato protein that is sold by AVEBE has a market value of $9.27 to $11/lb. The work conducted by graduate student Caleb Renshaw in the BSU FDIC has shown that 1 kg of Russet potatoes can yield about 300 g of starch and up to 6 g of protein. **Table 2** shows the economic breakdown for the ROI from 16M lbs. of surplus potatoes based on the results that Renshaw has obtained in the BSU FDIC. Low grade and surplus potatoes that are utilized for animal feed, allow the grower or processor to recover on the order of $10 per ton. In many instances, these potatoes are discarded as waste.

Table 2. Economics of IPP starch and protein from 16M lbs. of potatoes by 06/2028.

Input	**Quantity**	**Value**	**Extended Value**
Russet Potato	16M lbs./yr.	$10/ton (2,000 lbs.)	$80,000/yr. as feed
Starch	300 g starch/kg potato = 136.12 g/lb.	Market = $0.65/lb. 4.8M lbs. starch	$3.1M/yr.
Protein	6 g protein/kg potato = 2.722 g/lb.	Market = $9.00 per lb. 96,016 lbs. protein	$864,144/yr.
		Total	$4M/yr. as food

The data presented in **Table 2** shows that 16M lbs. of surplus and waste potatoes can generate on the order of $80,000/yr. if they are sold as animal feed. However, the value of these potatoes when upcycled into consumer grade starch and protein ingredients will gross nearly $4M/yr. The goal of this project is for IPP to create a processing operation that converts 2,000 lbs./hr. of potatoes, or 16M lbs./yr. into starch and protein ingredients. The IPP starch and protein business will operate 24 hrs./day, 7 days/wk., and employ three shifts of workers, where each shift will have two people in potato receiving and washing, one operator, two people in packaging, one supervisor, and one shipping coordinator. By the end of this 3-yr. IGEM HERC project, i.e., 06/2028, IPP will have 21 employees and generate $4M/yr. in gross revenue.

8. Criteria for Measuring Success

This project has been split into six milestones, two per year.

Year 1 - *Milestone 1* (07/2025-06/2026) sets the objective of obtaining and setting up the industrial scale equipment required for IPP to recover starch and potato juice in Glenns Ferry, ID. The processing of potatoes into starch at 2,000 lbs./hr. will require investment equating to $4M in infrastructure and equipment for receiving, rock removal, washing, sorting, rasping, centrifugation, hydrocyclone separation, vacuum filtration, flash drying, and packaging equipment. Gillette, Salamanca, Flores, and McFarland of IPP will finance the equipment for the starch and protein operation. While this equipment is being purchased and set up for use at the Genesis Organics

packaging facility, PI McDougal will manage *Milestone 2* (07/2025-06/2026), which is to generate sufficient quantity of potato starch and protein for functional and physical property assessment and market valuation. McDougal and his staff at the BSU FDIC will generate kg quantities of starch and protein by processing several hundred pounds of potatoes obtained from McFarland and Flores. They will measure the solubility, emulsification, foaming, texture, particle size, etc. of the starch and protein ingredients obtained from the processed potatoes. Samples of the starch and protein will be provided to Nichols at Ingredion and Ward at Glanbia for additional evaluation. Success in Yr. 1 will be measured by equipment acquisition and operational readiness by IPP, and potato ingredient technoeconomic analysis for starch and protein conducted by economist Dorland. Consumer grade ingredients must be produced in Yr. 1 to proceed to Yr. 2.

Year 2 – *Milestone 3* is to identify market alignment for Idaho produced potato starch and protein ingredients (07/2026-12/2026). Ingredion will assess the quality of starch, and Glanbia will assess the protein functionality for use in commercial beverages, RTM drink powders, supplements, nutrition bars, and other products. The twin screw extruder will be set up and operational at FP to permit product development of the extruded oat alternative meat products, and potato protein will be included in the Papa Latte formulation to assess consumer market potential by Cantley. *Milestone 4* is the IPP starch processing operation in Glenns Ferry that will produce ingredient and generate $250,000 in revenue from ingredient sales to customers that may include Ingredion, J.R. Simplot Co., McCain Foods, Lamb Weston, Cavendish Farms Foodservice, and Trinity Frozen Foods (12/2026-06/2027). By the end of Yr. 2, our team will have market outlets for starch and protein ingredients, produce and sell tons of starch, and have consumer beverage and alternative meat products prepared for sensory panel evaluation. Dorland will conduct an economic assessment of operations to guide future investment and course correct process inefficiencies. Revenue from ingredient sales must reach $250,000 in Yr. 2 to proceed to Yr. 3.

Year 3 – *Milestone 5* will focus on adding the protein ingredient production capability to the IPP starch operation (07/2027 – 12/2027). We propose to recover over 96,000 lbs./yr. of potato protein for sale as an ingredient, and use it in new consumer products including Papa Latte and extruded oat-based meat alternatives. *Milestone 6* includes the extension of ingredient and product offerings derived from additional research and development activities (01/2028 - 06/2028). The potato protein can be further separated into patatin for ingredient and supplements, and protease inhibitor II for weight management products that demand a market value closer to $11/lb. The potato fiber is also of value, and we may pursue its isolation to sell as an ingredient. Lastly, high quality extruded pet food and snacks may be pursued in our product portfolio.

9. Anticipated Development Challenges/Barriers

The work proposed for this project has been underway for several years. Significant momentum and investment have occurred to provide FDIC lab and pilot scale equipment for the conversion of potatoes into starch and protein. Current IGEM HERC investment is requested to bridge the gap between a BSU research project and the IPP commercial operation. Establishing the IPP starch and protein operation will require private contribution on the order of $4M for infrastructure and equipment. The quality of the starch and protein ingredient that IPP will produce must meet consumer standards to warrant the full $4M investment by McFarland and IPP. To mitigate this challenge, we have enlisted the expertise of economist Dorland, sensory scientist Cantley, and ingredient professionals Wu and Nichols at Ingredion, and Ward at Glanbia Nutritionals. We will confirm ingredient quality and predict economic returns each year to ensure we are on target to break even by or before 06/2028. Continued growth in processing capacity will lead to a profitable business with more than 21 new employees. Our 5-yr. plan is to continue to grow the operation to 28M lbs./yr. of potatoes processed by 07/2030, i.e., 8.4M lbs. starch, 168,000 lbs. protein, $7M/yr. gross revenue and 30 employees.

10. Budget: *See Form D: IGEM-HERC Full Proposal Budget Form*

11. Budget Justification

Year 1 Milestones 1 and 2: Establish a new potato starch and protein operation

LINE ITEM REQUEST	JUSTIFICATION	TOTAL $
Personnel	PI project management; research postdoc; GRA - lab	170,500
Equipment	Retsch starch drier; pilot scale flash drier for protein	105,000
Travel	Glenns Ferry; Burley/Twin Falls; Pocatello; Idaho Falls	5,400
Participant Support	Economist; Sensory Scientist	16,000
Other Direct Costs	GRA tuition/insurance; recharge center; supplies	39,600

For each year of this grant, 2 mo. of salary and fringe have been requested for PI McDougal to manage the project, a full-time postdoctoral researcher will work between the FDIC and FP, and PhD student Renshaw will conduct studies in the FDIC. The equipment requested includes a Retsch starch drier and a flash drier for protein with 10-20 kg/hr. capacity. The FDIC at BSU works with many food and dairy farms and process partners, so the equipment will be utilized after the award to continue research to benefit Idaho businesses. Travel is requested to meet monthly with IPP in Glenns Ferry, and quarterly with Glanbia in Twin Falls, Gibby Group in Burley, and Ingredion in Idaho Falls. The Idaho Potato Conference takes place each year in Pocatello, so networking has been included for this event. Economist Dorland will conduct technoeconomic assessment of the project as a paid consultant, and sensory scientist Cantley will organize sensory panels through her role at TechHelp at a cost of $2,500/panel and microbiological assessment of food products, est. at $500 per trial. Renshaw's tuition and health insurance are included in accordance with BSU graduate college rates. Recharge center fess are included for access to the Biomedical Research Institute at BSU for cell culture work, imaging, and mass spectrometry services beyond those available at the FDIC. Supplies have been itemized, and a complete list of products, quantities, vendors, and costs is available upon request.

Year 2 Milestones 3 and 4: Commercialize potato starch and protein ingredients

LINE ITEM REQUEST	JUSTIFICATION	TOTAL
Personnel	PI project management; research postdoc; GRA - lab	174,600
Equipment	Rheometer; extruder accessories for oat pulp products	109,800
Travel	Glenns Ferry; Burley/Twin Falls; Pocatello; Idaho Falls	5,400
Participant Support	Economist; Sensory Scientist	47,000
Other Direct Costs	GRA tuition/insurance; recharge center; supplies	36,000

The Yr. 1 budget description applies for Yr. 2 with a 3% increase in salaries as per university mandate. The rheometer is critically important to assess and evaluate slurries entering the extruder, and to characterize beverages formulated with potato protein. The extruder accessories are specific to produce the texture of meat from plant-based oat inputs. Additional funds are requested for Dorland's time for expanded economic assessment, and Cantley will conduct four sensory panels. The FDIC at BSU works with many food and dairy farms and process partners, so the equipment will be utilized after the award to continue research to benefit Idaho businesses.

Year 3 Milestones 5 and 6: Generate consumer products containing potato ingredients

LINE ITEM REQUEST	JUSTIFICATION	TOTAL
Personnel	PI project management; research postdoc; GRA - lab	178,800
Equipment	Texturometer – beverage & extruded product analysis	28,400
Travel	Glenns Ferry; Burley/Twin Falls; Pocatello; Idaho Falls	5,400
Participant Support	Economist; Sensory Scientist	23,000
Other Direct Costs	GRA tuition/insurance; recharge center; supplies	35,400

The Yr. 2 budget description applies to Yr. 3 with a 3% increase in salaries as per university mandate. The texturometer is essential to measure the texture, and evaluate the quality, extrusion, and shelf-life of oat based alternative meat products. The FDIC at BSU works with many food and dairy farms and process partners, so the equipment will be utilized after the award to continue research to benefit Idaho businesses.

12. Project Management – *See* ***Table 3.*** *Gantt chart for 3-yr. HERC timeframe*

Management structure: PI McDougal will coordinate the activities of the postdoc and PhD student Renshaw at the FDIC and FP. PI McDougal will coordinate oat pulp acquisition from Quast, ingredient evaluation by Nichols and Ward, communicate regularly with Gillette and McFarland to drive progress in Glenns Ferry, and initiate engagement by Dorland and Cantley. McDougal will provide talent and expertise to drive innovative research, Gillette and McFarland will deploy technology in the private sector, and economic returns for Idaho will be measured.

Table 3. Gantt chart for 3-yr. HERC timeframe

MILESTONES	2025	2026	2027	2028
IPP - acquire & setup industrial potato processing equipment	←	→		
FDIC - optimize starch and protein recovery – kg quantities consumer grade ingredients	←	→		
Product market assessment: Ingredion & Glanbia; FDIC sensory; begin extrusion		←	→	
IPP starch production and sales; $250K revenue by 06/2027; economic assessment		←	→	→
IPP protein ingredient production and sales; economic assessment; $4M/yr. revenue			←	→
FDIC/IPP beverages and extruded products to market; sensory evaluation			←	→

13. Additional Institutional and Other Sector Support

Boise State University has provided $2.5M in new laboratory spaces for the FDIC, where potato processing at the lab and pilot scale will occur. External partners will provide $4M in equipment, infrastructure (IPP & McFarland) for starch processing, extrusion in a food grade laboratory (FP, est. $101,000/yr.), and people to set up and operate the starch facility (est. 21 employees).

14. Future Funding

PI McDougal will submit a proposal to the NSF SEED FUND SBIR/STTR program in the topic area of Agriculture Technologies, and sub-topic of Food Waste Mitigation by 06/2027. This IGEM HERC proposal, as it relates to potato and oat processing byproduct conversion into higher value food ingredients and products, aligns with the NSF program that supports small business development at a level of up to $2M.

References

1) Riley, I.M., Impact of Potato Starch Structural Transitions on Microstructure Development During Deep-Frying. *Food Hydrocolloids*. **2023**, *142*, 108833. DOI: 10.1016/j.foodhyd.2023.108833
2) Kowalczewski, et. Al. The Nutritional Value of Biological Activity of Concentrated Protein Fraction of Potato Juice. *Nutrients*. **2019**, *11*, 1523. DOI: 10.3390/nu11071523
3) Hu, et. Al., Potato Proteins for Technical Applications: Nutrition, Isolation, Modification, and Functional Properties – A Review. *Innov. Food Sci. Emerg. Technol.* **2024**, *91*, 103533. DOI: 10.1016/j.ifset.2023.103533
4) Waglay, A., et. Al. Pilot Plant Extraction of Potato Proteins and their Structural and Functional Properties. *LWT – Food Sci. Technol.* **2019**, *113*, 108275. DOI: 10.1016/j.lwt.2019.108275
5) Alemayehu, G.F., et. Al. Nutritional and Phytochemical Composition and Associated Health Benefits of Oat (*Avena sativa*) Grains and Oat-Based Fermented Food Products. *The Scientific World Journal*. **2023**, 2730175. DOI: 10.1155/2023/2730175
6) Wang, A. Development of Protein-Enriched Biscuit Based on Oat-Milk Byproduct Fortified with Chickpea Flour. *LWT – Food Sci. Technol.* **2023**, *177*, 114594. DOI: 10.1016/j.lwt.2023.114594

Appendix A : Facilities and Equipment – Include a description of the available facilities and equipment. If equipment requests are part of the budget, include quotes here.

PI McDougal has 2,200 ft^2 of wet lab space located in the Micron Center for Materials Research on the Boise State University campus. McDougal has three wet bench laboratories that are well-equipped for natural products chemistry, food and dairy chemistry, and biomass extraction and component separation. In the 600 ft^2 lab there are two eight-foot fume hoods, an 18 MΩ-cm nanopure water system, Heidolph Hei-VAP rotary evaporator, two standard refrigerators, one commercial 47 ft^3 2-door fridge, one Fisherbrand Isotemp incubator, one VWR incubator, Malvern Zetasizer Ultra Particle Size Analyzer, two analytical balances, Hannah HI932 Automatic Potentiometric Titration System, LabConco FreeZone 2.5 plus lyophilizer with refrigerated CentriVap Concentrator, VELP SER 158/6 Series Automatic Solvent Extractor, Fisher Scientific Orbital Shaker, two Thermo Scientific UltiMate 3000 HPLC systems - both with diode array detectors, one with a fraction collector and the other with a charged aerosol detector, one Agilent 1260 Infinity II HPLC system with diode array, refractive index, and single quadrupole mass spectrometer detectors, and Peak Genius XE35 nitrogen generator. The HPLC systems all contain diode array detectors, and in addition each has unique functionality.

In another 600 ft^2 lab there is one eight-foot fume hood, one four-foot Kjeldahl hood, two 17.7 ft^3 commercial freezers, a chest freezer, two Fisherbrand Isotemp incubators, a Bruker MPA FT-NIR and Thermo Fisher Nicolet iS20 FT-MIR spectrometers, BioTek Epoch2 microplate reader UV-Vis spectrometer with cuvette holder, Agilent AriaMx RT-PCR 96-well plate system, Millipore Labscale TFF milk filtration system, an Agilent 7000E GCTQ-MS, FOSS DT 208 block digestor and KT 200 distillation Kjeldahl system, two analytical balances, Sartorius Entris II Advanced Precision Balance, OHAUS MB120 moisture analyzer, Aqualab TDL2 water activity meter, Thermo Scientific™ Thermolyne™ small benchtop muffle furnace, Eppendorf Centrifuge 5920R (max speed of 14000 rpm), QL Model 10 lab oven, Thermo Scientific CL2 and EKF Diagnostics Micro12 centrifuges, and two Benchmark myTemp mini incubators.

In the 1000 ft^2 lab there is one eight-foot fume hood, Pilotech YC-018 Pilot spray dryer, USALab lab-scale spray dryer, Teledyne Flodex powder flowability index test instrument, Thermo Scientific SWB 15 Precision water bath, Buchi R-114C24P B-480 rotary evaporator, Sartorius Entris II Essential Analytical Balance, CEM MARS 6 microwave digestion system, HunterLab Aeros Reflectance Spectrometer, LECO FP828P nitrogen/protein analyzer, Agilent 1290 HPLC-ELSD system, Agilent 7850 ICP-MS, Thermo Scientific Orion Aquafast AQ4500 turbidity meter, Aqualab Vapor Sorption Analyzer, Waters TA NanoDSC, Elea PEF-Pilot Dual and TC80, TetraPak 1812 pilot-scale filtration system, Agilent 1260 Infinity GPC system, Harvest Saver Dehydrator (R-5A), USALab 8-tray freeze dryer, USALab 50 L vacuum filtration unit, USALab 45 L SS jacketed centrifuge, 28 L Robo Coupe blender, large capacity mixing vessel, and a variety of small equipment.

McDougal is the Director of the Food and Dairy Innovation Center (FDIC), which is a full-service analytical chemistry recharge center accessible to internal university and external industrial partners. Students conduct food, dairy, and natural products chemistry research in the FDIC, which is complemented by additional core facilities on the Boise State campus that include the Biomedical Research Institute and the Boise State Center for Materials Characterization. The Biomedical Research Institute recharge facility in the Math Building, and it is staffed by professional scientists, under the direction of Distinguished Professor, Dr. Julie Oxford. Access to a multitude of mass spectrometry instrumentation, cell culture labs, and imaging capabilities are available. The Materials Characterization recharge center is in the Micron Center for Materials Research building, where access to surface imaging and state of the art microscopy equipment are accessible. Work with area industry involves food and dairy process chemistry, as well as evaluation of science and technology applications in food processing.

Equipment quotes are included in the following order:

(1) Retsch starch drier
(2) Flash drier for protein
(3) Rheometer
(4) Extruder – Select items (die, screws, etc.) from this quote that are required for alternative meat products will be charged to HERC
(5) Texturometer

QUOTE

QUOTE NUMBER:	2501894
CUSTOMER P.O.:	INQUIRY
ORDER DATE:	2/11/2025
CONTACT ID:	SA
CUSTOMER ACCT#:	0002926

Boise State University
Materials Science & Eng
1910 University Ave
Boise, ID 83725 United States

Ship To:

Boise State University
Materials Science & Eng
1910 University Ave
Boise, ID 83725 United States

TERMS
Net 30 days

SHIP VIA:	FEDEX FREIGHT
INCOTERMS:	FCA Newtown, PA
ATTN.:	Rose Saxton

LEAD TIME In stock subject to prior sale

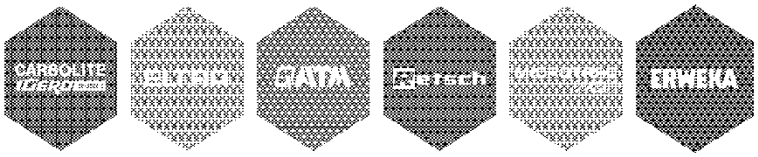
LINE #	Item Number	Unit	Qty	Price	Amount
1	707600001	EACH	1	12,986.50	12,986.50

TG200, 200-240V, 50/60HZ
- Includes clamp with filter bag
- PLEASE ORDER DRYING CONTAINER(S) SEPARATELY

Power cord without plug supplied with unit

Product Specifications:
- Gentle drying, dispersing and mixing also of temperature sensitive materials
- Very short drying times (~ 5 - 20 min)
- Powerful fan for optimal air throughput
- Easy handling
- Interval operation for better mixing of the fluidized bed
- Wide range of accessories including various containers
- Memory for up to 9 SOPs
- Motor with no brushes allows for long service life

Technical Specifications:
- Applications: drying
- Feed material: bulk materials and solids
- Material feed size: > 100 µm
- Volume flow: 185 m3/h
- Time setting digital: 1 - 99 min / continuous operation
- Storable SOPs: 9
- Temperature control: (continuously adjustable) 40 - 130 °C (depending on air throughput rate)
- Drying time: 5 - 20 min (depending on product, quantity, moisture content)
- Container volume: 1 x 6 l / 3 x 0.3 l
- Electrical supply: 200-240 V, 50/60 Hz
- Power connection: 1-phase



QUOTE

- W x H x D (mm): 400 x 1000 x 480
- Net weight: ~ 21 kg
- Standards: CE
- Country of Origin: Germany
- Tariff Number: 84193900

LINE #	Item Number	Unit	Qty	Price	Amount
2	727830001 DRYING CHAMBER GLASS 6 LITRES - For use in TG100/200 - Country of Origin: GERMANY - Tariff Code: 84199085	EACH	1	2,118.50	2,118.50

LINE #	Item Number	Unit	Qty	Price	Amount
All orders should be sent to info-us@verder-scientific.com. Please reference your quote # (if applic					

LINE #	Item Number	Unit	Qty	Price	Amount
Freight Estimated Freight charges can be applied as prepay & add OR collect (with account number p					

LINE #	Item Number	Unit	Qty	Price	Amount
For credit card purchase transactions over $5,000.00, there will be an additional 3.5% fee charge.					

LINE #	Item Number	Unit	Qty	Price	Amount
5% University Discount Applied					

*** The Delivery Date/Lead Time is best estimate and approximate only as it is not yet confirmed but subject to material availability**
**** Our general terms and conditions apply**
***** Validity of prices: 12/31/2025**

Net Order:	15,105.00
Freight:	400.00
Order Total:	15,505.00

Verder Scientific, Inc.
11 Penns Trail, Suite 300
Newtown, PA 18940

Telephone: 866-473-8724
Fax: 267-757-0358

Website: www.verder-scientific.com
Email: info-us@verder-scientific.com

Streamline Precision Manufacturing LLC
120 South 100 West
Burley, ID 83318

Phone: 2086789367
Fax: 2086789229

Proposal

Proposal: 100944
Date: 2/24/2025

To:	Project:
Boise State University Attn: Owen M McDougal Ph.D. 1910 University Drive Boise, ID 83725	Boise State GFD-4 Laboratory Flash Dryer

Salesperson		
Victor Rodriguez		

Scope of Work

GFD-4 Laboratory Flash Dryer
Production Capacity 10-20 kgs. per hour
Working temperature 0-200C

1) Main Unit Specification: 200

(2) Main Unit Evaporation Capacity: 10-20 kg/h(Based on Inlet Air Temperature: 140-200C, Outlet Air Temperature:120-100 C)

(3) Main Unit Installed Power: 0.75 kW, Variable Frequency Speed Control: 200-450 rpm

(4) Main Unit Components:

a. Base, Bearing Housing: Stainless Steel 10mm, Casting (Bearing Housing Water Cooled)
b. Tangential Air Inlet Volute: Inner Wall Made of Stainless Steel 3mm, Stainless Steel 1.5mm. With 75mm Insulation Layer, Aluminum Silicate Insulation Cotton
c. Rotary Crushing Blade: Bearing Housing Carbon Steel, Main Shaft 45#, Blade Casting Stainless Steel
d. Cooling Jacket: Inner Wall Stainless Steel 4, Outer Wall Stainless Steel 1.5
e. Straight Pipe: 200, 1 Section, Inner Wall Made of Stainless Steel 2, Outer Wall Stainless Steel 1.5, With 75mm Insulation Layer, Aluminum Silicate Insulation Cotton
f. Tangential Air Outlet Cap: 200, Inner Wall Made of Stainless Steel 2, Stainless Steel 1.5, With 70mm Insulation Layer, Aluminum Silicate Insulation Cotton
g. Fan: Induced Draft Fan: 9-19-2.2 kW, Stainless Steel Material, Air Volume: 824-1704 m3/h

Unit Price Delivered Boise, Idaho

Proposal Total:	89,450.00

Acceptance

Accepted by: _____

Title: _____

Date: _____

Anton Paar

Boise State University
Attn: Elizabeth Ryan
1910 University Dr
Boise ID 83725-0002

Delivery Address
Boise State University
Attn: Elizabeth Ryan
1910 University Dr
Boise ID 83725-0002

Quotation 820254751

Date: 11/02/2023

Customer Reference:	
Customer No.:	226630
Quotation valid until:	02/02/2024

Your Contact Partner at Anton Paar USA, Inc.:

Name:	Ms. Onome Agori-Iwe
Telephone:	+1-310-775-2196 - X450
Mobile:	+1 - 360 - 600 - 3777
Email:	onome.agori-iwe@anton-paar.com

Dear Ms. Elizabeth Ryan,
Referring to your request we are pleased to submit the following quotation.

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
000100	**MCR 92** **MODULAR COMPACT RHEOMETER** **159000** | 90278990 | AT (1) - computer controlled compact laboratory rheometer with an air bearing supported electronically commutated synchronous motor drive system to perform rotational and oscillatory tests - high energy efficiency by using air cooled peltier temperature control systems - easy handling and high precision by Automatic Gap Setting (AGS) and the unique measuring gap illumination TruRay - absolutely reliable by automatic tool recognition and intelligent configuration system (Toolmaster) Technical data please see from enclosed brochure. RUS: RU 2014 833 3K	1 EA	31,450.00	-50.00 %	**15,725.00**

Anton Paar

Quotation 820254751

Date: 11/02/2023

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
000102	**Anton Paar Preventive Maintenance On-Site** **P01078** | 90279000 | AT *This item belongs to position 000100.* This service includes: - Check of the instrument and ambient conditions - Instrument cleaning - Replacement of normal wear parts - Inspection of critical components - Adjustments as needed - Performance Verification - Maintenance Report This service will be carried out at the customer's facility by a certified Anton Paar service engineer following relevant factory standards, using calibrated and certified tools.	2 EA	3,606.00	-5.00 %	**6,851.40**
000200	**RHEOMETER SOFTWARE RheoCompass LIGHT** **104632** | 85423275 | DE - more than 100 predefined and customizable measurement templates (apps) - available in 8 languages (English, German, Chinese, Japanese, French, Portuguese, Spanish, Polish) - central database handles all relevant data and ensures data security - countless analysis methods for routine and advanced data analysis - full automation possible (from preparation to printout of results) - single software license including one rheometer driver (for MCR 51, 52, 72, 92 or RheolabQC) - running under Microsoft Windows 10 and 11 - recommended hardware: Intel™ i5 Dual Core, 3rd Gen "Ivy Bridge", 2.6 GHz or higher, SSD with 512 GB or more For more details please refer to the brochure or website	1 EA	3,057.00	-50.00 %	**1,528.50**
000300	**P-PTD 220/AIR FOR MCR x2 PELTIER TEMPERATURE DEVICE (PLATE)** **247229** | 90279000 | AT - temperature range: -10°C to 220°C (low temperature range depents on ambient conditions) - plate with active Peltier temperature control (heating/cooling) - for cone/plate and parallel plate measuring geometries - with built-in fan for air counter-cooling	1 EA	5,460.00	-25.00 %	**4,095.00**

Anton Paar

Quotation 820254751

Date: 11/02/2023

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	- with universal plate holder (screw-on thread) for use of measuring plates (also disposable) and other accessories - with Toolmaster for automatic tool recognition and configuration - installation in the rheometer through three-point support without the risk of misalignment - maximized torsional stiffness due to constructional torque support				
000400	**H-PTD 200/AIR/18P** **AIR-COOLED PELTIER HOOD** **159003** | 90279000 | AT - for cone/plate and parallel plate measuring geometries, - with integrated fan for counter cooling CoolPeltier, - incl. flow valve, - temperature range: -5* to 200 °C. * Lower temperature range depends on ambient conditions.	1 EA	8,850.00	-25.00 %	**6,637.50**
000500	**AIR DISTRIBUTOR MCR X2** **169190** | 84879090 | AT - required for an active temperature hood in combination with MCR X2 - preset pressure 3 bar rel. RUS: RU 2014 833 3K	1 EA	227.00		**227.00**
000600	**MEASURING PLATE PP25** **D: 25 mm** **79044** | 90279000 | AT	1 EA	1,329.00	-25.00 %	**996.75**
000700	**MEASURING CONE CP50-1** **D: 50 mm; ANGLE 1°** **79040** | 90279000 | AT	1 EA	1,651.00	-25.00 %	**1,238.25**
000800	**C-PTD 150/XL/AIR/18P** **AIR COOLED PELTIER TEMPERATURE DEVICE** **166901** | 90279000 | AT - for concentric cylinder measuring geometries - with integrated fan for counter cooling CoolPeltier - temperature range: +5*) to 150 °C *) The lower temperature range depends on the ambient conditions.	1 EA	7,620.00	-25.00 %	**5,715.00**
000900	**STANDARD MEASURING SYSTEM** **CC39/T200/XL/SS** **18346** | 90279000 | AT consisting of: - measuring cylinder B-CC39/Q1	1 EA	3,334.00	-25.00 %	**2,500.50**

Anton Paar

Quotation 820254751

Date: 11/02/2023

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	- measuring cup C-CC39/T200/XL/SS				
001000	**MCR X2 EDU PACKAGE** **177025** | 90279000 | AT consists of: - 1 copy of Applied Rheology – With Joe Flow on Rheology Road The book can be reordered once a year for each student for free - Anton Paar USB stick (including studying materials) - posterset MCR XX2 Evolution - 5 pcs spatula - notepad - pen - post-it pad - "See things change" spinning top	1 EA	139.00	-100.00 %	**0.00**
001100	**RHEO BOOK; "APPLIED RHEOLOGY"** **161852** | 49019900 | AT	10 EA	107.00	-100.00 %	**0.00**
001200	**Anton Paar Training** **P01174** | 90279000 | AT This service includes: - End User Training on the use of the instrument, proper upkeep and cleaning - Training Certificate for every participant The training will be carried out by qualified Anton Paar personnel.	1 EA	0.10	-100.00 %	**0.00**
001300	**ViscoQC 300 – L** **ROTATIONAL VISCOMETER** **105023** | 90278990 | AT (2) Includes set of 4 L spindles, stand, power supply, instruction manual, SOP, USB cable, V-Collect RUS: RU 2014 833 3K	1 EA	6,260.00	-100.00 %	**0.00**
001400	**AP Connect START** **SOFTWARE FOR PAPERLESS LAB** **254078** | 85234990 | AT - Laboratory software to collect, analyze and export (PDF-, CSV-format) measurement data. - Collection of all data in a central database with single-user access - Free license for connection to and data transmission from a single Anton Paar instrument - Operates as desktop or server installation For more details, please refer to brochure or website.	1 EA			

Anton Paar

Quotation 820254751

Date: 11/02/2023

Sum of Positions	**USD**	**45,514.90**
Freight	USD	475.00
Tax	USD	0.00
Total Amount CIP Boise	**USD**	**45,989.90**

Available Options

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
001304	***Anton Paar Preventive Maintenance In-House*** **P01127** | 90279000 | AT	*2 EA*	*1,061.00*	*-5.00 %*	***2,015.90***

This item belongs to position 001300.

This service includes:
- Check of the instrument and external conditions
- Instrument cleaning
- Replacement of normal wear parts
- Inspection of critical components
- Adjustments as needed
- Performance Verification
- Maintenance Report

This service will be carried out at Anton Paar's workshop by a certified Anton Paar service engineer following relevant factory standards, using calibrated and certified tools.

Conditions

Delivery Time:	Approx. 4-6 weeks after receipt of purchase order
Terms of Delivery:	CIP Boise
Transport by:	Truck
Terms of Payment:	Within 30 days due net

Anton Paar

Quotation 820254751

Date: 11/02/2023

Additional Information

3-year warranty applies solely on purchased instrument(s). Consumable items and any spare parts purchased separately are excluded from this warranty.
(1) This instrument requires regular scheduled service. The 3 year warranty will only be applicable if the service is carried out in accordance with the instrument maintenance plan.
(2) For this instrument a regular scheduled service is recommended to ensure proper instrument functionality and the highest performance and reliability.

Payment terms are subject to change upon credit review at time of order placement.

Further Regulations

The Equal Opportunity Clauses set forth in 41 CFR Section 60-1.4(a), 60-741(a) - (f), 60-250.4(a) and 29 CFR Part 471, Appendix A are incorporated herein by reference.

General Terms and Conditions

The General Terms of Delivery of Anton Paar USA, Inc. in compliance with Incoterms in the most recent valid version exclusively apply to the contract. For the usage of the software the End User License Agreement applies in the most recent valid version. The General Terms of Delivery are available at www.anton-paar.com/terms.

Liability

Any and all claims that may arise out of or in connection with the present contract are limited in total to the value of present order. Any claims exceeding this limitation of liability are expressly excluded.

Looking forward to receiving your kind order we remain
sincerely yours,

Anton Paar USA, Inc.

Anton Paar

Boise State University
1910 University Dr
Boise ID 83725-0002

Delivery Address
Boise State University
1910 University Dr
Boise ID 83725-0002

Quotation 820274896

Date: 02/10/2025

Customer Reference:	
Customer No.:	226630
Quotation valid until:	05/07/2025

Your Contact Partner at Anton Paar USA, Inc.:

Name:	Mr. Kevin Ritchey
Telephone:	+1-310-775-2196
Mobile:	+1 - 310 - 781 - 0798
Email:	kevin.ritchey@anton-paar.com

Dear Ms. Rose Saxton,
Referring to your request we are pleased to submit the following quotation.

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
000100	**EXTRUDER TWINLAB F 20/40 (WITHOUT LINER)** **282392** | 90279000 | DE Main connection: 3 x 230 V, 50/60 Hz + PE, 76A Stand-alone twin screw extruder in hygienic design for extruding small quantities of material and additives in laboratory scale. Integrated touch-panel with MetaBridge-software and CAN-open BUS Technology allows production simulation and scale-up possibilities. - mobile carrier - drive: 16 KW - max. torque: 80 Nm, 40 Nm per screw - max. screw speed: 1200 rpm - 4 Heating- / Cooling-Zones (electrical heating / water cooling), 7,2KW heating power - nozzle with 4 heating zones /2,4 KW per zone - max. temperature: 400 °C	1 EA	155,520.00		**155,520.00**

Anton Paar

Quotation 820274896

Date: 02/10/2025

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	- max. pressure: 350 bar - die head connection: with 2 3/4“ threaded ring - processing unit: co-rotation - capacity: 1-20 kg/h (dependent on product) Dimensions: 2013mm x 606,5mm x 1205mm (LxDxH) excl. monitor 2013mm x 606,5mm x 1566mm (LxDxH) incl. monitor - weight: approx. 480 kg In addition to the feed opening at 0 L/D, three further				
	DU: 1B118 GKV: 1B118				
000200	**LINER FOR TSE 20/40D** **MADE OF M390** **284910** | 84779080 | DE high abrasion resistancy	1 EA	23,500.00		**23,500.00**
000300	**1 PAIR OF SCREWS:** **SCREW CONFIGURATION FOR:** **285859** | 84779080 | CN compounding purpose, universal screw diameter: 20 mm barrel length: 40 D axle gauge: 16.5 mm flight depth: 3.75 mm number of flights: 2 max. torque: 80 Nm (40 Nm per screw) On request and after technical clarification: Optimizing of screw configuration for individual application	1 EA	21,630.00		**21,630.00**
000400	**WATER-TEMPERING DEVICE MODEL WTD 2ES** **ADJUSTMENT RANGE UP TO 140°C, PRESSURE** **286077** | 84198998 | DE superimposed. Mains supply: three-phase A.C 230 V, 60 Hz. Technical Data: heating capacity: 2kW cooling capacity: 15 kW at preliminary temperature of 90°C circulation pump max.: 0.37 kW/30 l/min/ 5 bar safety valve: 6 bar control voltage: 24 V/DC connector plug: CEE 16 A, 3 m electrical conn. value: 2.4 kW connectors (flow + return): Tempering: G 3/8”m IG cooling water: G 3/8” IG	1 EA	7,020.00		**7,020.00**

Anton Paar

Quotation 820274896

Date: 02/10/2025

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	weight: approx.. 45 kg				
000500	**HOPPER APPROX 3L** **FOR TSE 20/40 VERTICAL FEEDING OPENING** **282509** | 84482000 | DE	1 EA	1,206.00		**1,206.00**
000600	**TRANSDUCER 10K PSI (CAN OPEN) PRESSURE** **ONLY. POSITION #1 WITH ADAPTER MODULE** **295347** | 90278990 | US and CableKD0-7-H-P10M-1-4-0-S-1OV 2130X010X00	1 EA	2,842.00		**2,842.00**
000700	**THERMOCOUPLE (STRAIGHT EXECUTION) WITH** **COMPENSATION** **285310** | 90251900 | DE lead for measuring the stock temperature in measuring Extruders and die-heads	2 EA	668.00		**1,336.00**
000800	**THERMOCOUPLE LEAD WIRE ASSEMBLYTYPE** **'J" 80" LONG WITH ST. ST. FLEXIBLE** **295688** | 90278990 | US hose protection, with one female & one male connectorwith pull protection our Dwg. #EL-251-B	2 EA	153.00		**306.00**
000900	**ADAPTER CABLE 6 FEET LONG - CWB DIES TO** **TSE AND CTSE-V** **295319** | 90278990 | US	1 EA	287.00		**287.00**
001000	**SEALING PLUG, DSE20, M390, DUPLEX CR-CN** **315101** | 83099090 | EU	1 EA	2,018.00		**2,018.00**
001100	**PERISTALTIC PUMP MODEL 323DU/D** **HOUSING DRIVE FOR MANUAL OPERATION AND** **282614** | 90279000 | DE external control, powder-coated housing, 25-pin D-connector on the back of the pump Digital speed control in 1upm steps from 3.0 to 400min-¹, 133:1 adjustment range Direct input of speed via membrane keypad and display possible	1 EA	10,590.00		**10,590.00**

Anton Paar

Quotation 820274896

Date: 02/10/2025

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	Speed control via analog signals 4-20mA or 0-10V digital TTL signal or remote switch for stop/start and change of the direction of rotation quick and easy insertion of the hose into the 313 pump head. Extension pump heads with snap closure for up to six delivery channels protection class IP31 313D pump head for tubing with a wall thickness of 1.6mm Delivery rates from 0.81 to 2,000ml/min integrated in Brabender MetaBridge Intrastat code 84136080 Country/region of origin United Kingdom Gross weight (kg) 4,000				
001200	**"DOSING BOLT 1/2""20UNF-Ø3.5"** **282561** | 73182900 | DE	1 EA	1,050.00		**1,050.00**
001300	**ROUND DIE ASSEMBLY FOR EXTRUDER "WITH THREADED RING NUT 2 3/4"":"** **282804** | 90279000 | DE electrical heater band, 615 watts, 240 V, 50/60 Hz, max. 450°C with 1 "threaded boring 1/2"" x 20 UNF for stock temperature thermocouple or" pressure transducer, without nozzles interchangeable nozzles for round die assembly.	1 EA	2,362.00		**2,362.00**
001400	**EXTRUDER CUTTING DEVICE HYGIENIC DESIGN INCLUDING CONTROL UNIT FOR CUTTING OF** **284990** | 84798997 | DE (2) extrudates up to max. Ø 19mm with exchangeable die inserts. Cutting rotor incl. 8-blade reversible knife. Rotor speed continously adjustable up to 1125 min-1, Voltage: 1 x 230 V, 50/60 Hz +N +PE 16 A.	1 EA	22,770.00		**22,770.00**
001500	**NOZZLE, Ø 3.0 MM** **282770** | 90279000 | DE	1 EA	441.00		**441.00**
001600	**NOZZLE, Ø 5.0 MM** **282772** | 90279000 | DE	1 EA	473.00		**473.00**
001700	**NOZZLE, Ø 8.0 MM** **282792** | 90279000 | DE	1 EA	473.00		**473.00**
001800	**BRABENDER TWIN-SCREW FEEDER DDSR20 FOR CONTINUOUS VOLUMETRIC DOSING OF** **282981** | 90279000 | DE	1 EA	17,580.00		**17,580.00**

Anton Paar

Quotation 820274896

Date: 02/10/2025

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	Speed control via analog signals 4-20mA or 0-10V digital TTL signal or remote switch for stop/start and change of the direction of rotation quick and easy insertion of the hose into the 313 pump head. Extension pump heads with snap closure for up to six delivery channels protection class IP31 313D pump head for tubing with a wall thickness of 1.6mm Delivery rates from 0.81 to 2,000ml/min integrated in Brabender MetaBridge Intrastat code 84136080 Country/region of origin United Kingdom Gross weight (kg) 4,000				
001200	**"DOSING BOLT 1/2""20UNF-Ø3.5"** **282561** | 73182900 | DE	1 EA	1,050.00		**1,050.00**
001300	**ROUND DIE ASSEMBLY FOR EXTRUDER "WITH THREADED RING NUT 2 3/4"":"** **282804** | 90279000 | DE electrical heater band, 615 watts, 240 V, 50/60 Hz, max. 450°C with 1 "threaded boring 1/2"" x 20 UNF for stock temperature thermocouple or" pressure transducer, without nozzles interchangeable nozzles for round die assembly.	1 EA	2,362.00		**2,362.00**
001400	**EXTRUDER CUTTING DEVICE HYGIENIC DESIGN INCLUDING CONTROL UNIT FOR CUTTING OF** **284990** | 84798997 | DE (2) extrudates up to max. Ø 19mm with exchangeable die inserts. Cutting rotor incl. 8-blade reversible knife. Rotor speed continously adjustable up to 1125 min-1, Voltage: 1 x 230 V, 50/60 Hz +N +PE 16 A.	1 EA	22,770.00		**22,770.00**
001500	**NOZZLE, Ø 3.0 MM** **282770** | 90279000 | DE	1 EA	441.00		**441.00**
001600	**NOZZLE, Ø 5.0 MM** **282772** | 90279000 | DE	1 EA	473.00		**473.00**
001700	**NOZZLE, Ø 8.0 MM** **282792** | 90279000 | DE	1 EA	473.00		**473.00**
001800	**BRABENDER TWIN-SCREW FEEDER DDSR20 FOR CONTINUOUS VOLUMETRIC DOSING OF** **282981** | 90279000 | DE	1 EA	17,580.00		**17,580.00**

Anton Paar

Quotation 820274896

Date: 02/10/2025

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
	powdery bulk solids: - Bulk weight: 0.5 kg / dm3 - Flow characteristics: medium - Dosing rate: 0.5-1.5 kg / h The twin-screw feeder consists of the following modules: - Twin screw feeder type TC20 / 12 - Trough-mixer system - Three-phase motor 230/400 Volt, 0.18 KW (drive screw and agitator) "Version according to enclosed factory standard ""Brabender twin-screw" "feeder type DDSR20 "" " - Rectangular container, volume 10 dm3 - Lid for attachment container with handle for manual filling, material 1.4301 - Safety grid for manual filling - Material 1.4571				
001900	**SCREW TC20/20 FOR DDSR20PRODUCT: POWDER FLOW PROPERTIES: FOR FLUIDIZING AND** **296249** | 90278990 | EU extremely poor flowing bulk materials Particle size: µm range Bulk density: 0.5 kg/dm³ (as an assumption) Dosing capacity: 3 - 20 kg/h* (with barrel 223) Product temperature: room (23°C as assumption) Ambient temperature: room (23°C as assumption) Humidity: dry *Subject to product sampling or, if applicable, dosing tests dosing tests still to be carried out. Subject to change of Subject to change without notice.	1 EA	1,391.00		**1,391.00**
002000	**SET OF TOOLS - TWINLAB-F 20/40** **284930** | 84779080 | DE	1 EA	1,922.00		**1,922.00**
002100	**CLEANING TOOLS FOR TWINLAB-F 20/40** **284932** | 84779080 | DE	1 EA	683.00		**683.00**
002200	**SCREW ELEMENT CONVEYOR PART SE-I-20/20/R TH-12** **285803** | 84779080 | DE	2 EA	356.00		**712.00**
002300	**SCREW ELEMENT CONVEYOR PART SE-I-30/30/R 1.4112** **285811** | 84779080 | CN	2 EA	426.00		**852.00**

Anton Paar

Quotation 820274896

Date: 02/10/2025

Pos.	Item Description Item No. | Cust. Tariff No. | Origin	Qty. Unit	Price per Unit in USD	Pos. Disc.	Amount in USD
002400	**SCREW ELEMENT KNEADING BLOCK KWB-I-45/5/30/R** **285821** | 84779080 | EU	2 EA	518.00		**1,036.00**
002500	**SCREW ELEMENT KNEADING BLOCK KBW-I-45/5/20/R TH-12** **285832** | 84779080 | DE	2 EA	384.00		**768.00**
002600	**FEEDER SUPPORT FOR TWINLAB-F / TWINLAB-CCAN BE USED FOR ONE FREE FALL** **282586** | 73269098 | DE dosing system!	1 EA	1,722.00		**1,722.00**
002700	**SCREW CONFIGURATION SOFTWARE PACKAGE FOR WINDOWS 2000, XP, VISTA, WINDOWS 7,** **284948** | 84779080 | DE Windows 8, Windows 10 optional in Connection with twin screw extruder TSE 20/40 D / TSE 12/36 D	1 EA	3,100.00	-100.00 %	**0.00**
002800	**Training TEX** **P01538** | 90279000 | DE	2 EA	2,500.00	-100.00 %	**0.00**
002900	**Installation TEX** **P01488** | 90279000 | DE	1 EA	4,000.00	-100.00 %	**0.00**
Sum of Positions			**USD**		**280,490.00**
Freight			USD		12,000.00
Tax			USD		0.00
Total Amount CIP Boise			**USD**		**292,490.00**

Conditions

Delivery Time:	Approx. 18-20 weeks after receipt of purchase order
Terms of Delivery:	CIP Boise
Transport by:	Truck
Terms of Payment:	Variable terms of payment

Anton Paar

Quotation 820274896

Date: 02/10/2025

Additional Information

3-year warranty applies solely on purchased instrument(s). Consumable items and any spare parts purchased separately are excluded from this warranty.
(2) For this instrument a regular scheduled service is recommended to ensure proper instrument functionality and the highest performance and reliability.

Special Payment Terms:

50% down payment with order placement
40% due after successful and accepted Factory Acceptance Test (FAT) OR prior shipping instrument
10% due within 30 days after successful installation, not to exceed 45 days of invoice date

Goods in this quotation are subject to national and international trade and export control laws and regulations ("Export Regulations"). The parties acknowledge that any sale, (re)export or other transfer of the goods contrary to the Export Laws is prohibited and therefore, Anton Paar may cancel this quotation at any time without any liability to the buyer. The buyer is responsible for its own compliance with Export Regulations.
In case Anton Paar has to apply for an export license, the provided delivery timeframe is calculated from the issuance of the respective export license.

Further Regulations

The Equal Opportunity Clauses set forth in 41 CFR Section 60-1.4(a), 60-741(a) - (f), 60-250.4(a) and 29 CFR Part 471, Appendix A are incorporated herein by reference.

General Terms and Conditions

The General Terms of Delivery of Anton Paar USA, Inc. in compliance with Incoterms in the most recent valid version exclusively apply to the contract. For the usage of the software the End User License Agreement applies in the most recent valid version. The General Terms of Delivery are available at www.anton-paar.com/terms.

Liability

Any and all claims that may arise out of or in connection with the present contract are limited in total to the value of present order. Any claims exceeding this limitation of liability are expressly excluded.

Looking forward to receiving your kind order we remain
sincerely yours,

Anton Paar USA, Inc.

Texture Technologies Corp. 6 Patton Drive, Hamilton, MA 01982 914-472-0531

Quote To
Mark Skinner
Boise State University
1910 University Drive
Boise, Idaho, 83725

Quote Info	
Quote Number	2024-10-21 TY BoiseState Plus
Valid Until	2024-12-02
TTC Representative	Tracy Yates
TTC Rep	tracy@texturetechnologies.com
TTC Rep Phone	970-222-3213

Qty	Part Number	Quoted Line Item	Discount	Line Total
1.00	TA50/650E	TA XTPlusC Texture Analyser 650H w Exponent	5.00%	$27,075.00
	With 50kg Load Cell			
1.00	2kg CW	2 kg calibration weight	0.00%	$200.00
1.00	TA-071	Converter plug M6 to M3	0.00%	$130.00
1.00	TA-090	Heavy duty platform w one aluminium or Lexan plate	0.00%	$640.00
1.00	Training	Installation & Training	0.00%	$1,300.00
1.00	Discount Online Training	Discount Online Training	0.00%	$-1,300.00
1.00	CIF-400	Crating Insurance and Freight - Estimated	0.00%	$400.00

Subtotal:	$29,870.00
Discount:	$1,425.00
Total US$	$28,445.00

Terms are Net 30 days from shipment. If a longer payment term is required then the following charges apply: 0.5% for Net 45; 1% for Net 60; 1.5% for Net 90. Please request permission for credit card transactions greater than $3,000 due to high bank fees. ACH transfers or checks are preferred for all payments.There are no bank fees if payment is made with a corporate check in US$ drawn on a US bank or if the check has a routing number starting with 0260. Bank charges of $140 will be passed through for Canadian bank system checks. The parts and labor warranty on all new instruments is for 2 years, except load cells which are not covered by warranty.The parts and labor warranty for all other items is for 12 months. Shipment is normally within 8 weeks after receipt of order, but could be longer due to short-term Covid-19 related delays. Shipment is by FedEx with insurance, FOB Destination, prepaid and added to the invoice. Texture Technologies does not collect sales tax except in California where applicable State and County taxes will be applied. Purchaser may be responsible for use taxes and duties, depending on their own circumstances.

Thank you for your interest in our texture analyzer system and related fixtures. We appreciate the opportunity to partner with you and to share our expertise with your team.

Sincerely,

Texture Technologies Corp.

Tracy Yates

Appendix B : Biographical Sketch – 3 pages. Academic PIs and co-PIs must provide a biographical sketch using the NSF format, with the exception that it be no longer than 3 pages (see NSF format via PAPPG https://nsf-gov-resources.nsf.gov/files/nsf24_1.pdf).

IDENTIFYING INFORMATION:

NAME: McDougal, Owen

ORCID iD: https://orcid.org/0000-0002-1502-3462

POSITION TITLE: Professor; Director, Food and Dairy Innovation Center

PRIMARY ORGANIZATION AND LOCATION: Department of Chemistry and Biochemistry, Boise State University, Boise, Idaho, United States

Professional Preparation:

ORGANIZATION AND LOCATION	DEGREE (if applicable)	RECEIPT DATE	FIELD OF STUDY
University of Utah, Salt Lake City, Utah, US	Ph.D.	05/1998	Chemistry
State University of New York at Oswego, Oswego, NY, US	BS	05/1992	Chemistry
State University of New York at Geneseo, NY, NY, US	AS	05/1990	Chemistry

Appointments and Positions

2021 - present	Professor; Director, Food and Dairy Innovation Center , Department of Chemistry and Biochemistry, Boise State University, Boise, Idaho, United States
2018 - present	Advisory Board Member, Western Dairy Center , Logan, UT, United States
2016 - 2023	Chair, Department of Chemistry and Biochemistry, Boise State University, Boise, ID, United States
2006 - 2023	Professor, Boise State University, Chemistry and Biochemistry, Boise, ID, US
1998 - 2006	Assist/Assoc. Professor, Southern Oregon University, Chemistry, Ashland, Oregon, US

Products

Products Most Closely Related to the Proposed Project

1. Saxton R, McDougal O. Whey Protein Powder Analysis by Mid-Infrared Spectroscopy. Foods. 2021 May 10; 10(5):1033-. Available from: https://www.mdpi.com/2304-8158/10/5/1033 DOI: 10.3390/foods10051033
2. Skinner M, Seale J, Cantrell M, Collins J, Turner M, McDougal O. Instrumentation for Routine Analysis of Acrylamide in French Fries: Assessing Limitations for Adoption. Foods. 2021 August 30; 10(9):2038-. Available from: https://www.mdpi.com/2304-8158/10/9/2038 DOI: 10.3390/foods10092038
3. Skinner M, Fong M, Rimkus T, Hendricks A, Truong T, Woodbury L, Pu X, McDougal O. Pulsed Electric Field Treatment of Sweet Potatoes to Reduce Oil and Acrylamide in Kettle Chips. Foods. 2025 February 10; 14(4):577-. Available from: https://www.mdpi.com/2304-8158/14/4/577 DOI: 10.3390/foods14040577
4. Saxton R, Lahey C, Smith B, Hibberd E, Bevan J, Baumhoff C, Galant A, Young J, Meyer B, McDougal O. Impact of pulsed electric field treatment on barley germination for malting. LWT. 2024 April; 197:115882-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0023643824001610 DOI:

10.1016/j.lwt.2024.115882

5. Babatunde H, Collins J, Lukman R, Saxton R, Andersen T, McDougal O. SVR Chemometrics to Quantify β-Lactoglobulin and α-Lactalbumin in Milk Using MIR. Foods. 2024 January 03; 13(1):166-. Available from: https://www.mdpi.com/2304-8158/13/1/166 DOI: 10.3390/foods13010166

Other Significant Products, Whether or Not Related to the Proposed Project

1. Cantrell M, Wall J, Pu X, Turner M, Woodbury L, Fujise K, McDougal O, Warner L. Expression and purification of a cleavable recombinant fortilin from Escherichia coli for structure activity studies. Protein Expression and Purification. 2022 January; 189:105989-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1046592821001728 DOI: 10.1016/j.pep.2021.105989
2. Seale J, Carpenter J, Eisenstat M, Kiernan E, Morgan B, Nogee D, Pu X, Therriault C, Yeh M, McDougal O. *Veratrum parviflorum* poisoning: identification of steroidal alkaloids in patient blood and breast milk. Clinical Toxicology. 2022 October 27; 60(12):1309-1317. Available from: https://www.tandfonline.com/doi/full/10.1080/15563650.2022.2132166 DOI: 10.1080/15563650.2022.2132166
3. Cantrell M, McDougal O. Biomedical rationale for acrylamide regulation and methods of detection. Comprehensive Reviews in Food Science and Food Safety. 2021 January 23; 20(2):2176-2205. Available from: https://ift.onlinelibrary.wiley.com/doi/10.1111/1541-4337.12696 DOI: 10.1111/1541-4337.12696
4. Dirks M, McDougal O. Pharmacology of Veratrum californicum Alkaloids as Hedgehog Pathway Antagonists. Pharmaceuticals. 2024 January 17; 17(1):123-. Available from: https://www.mdpi.com/1424-8247/17/1/123 DOI: 10.3390/ph17010123
5. Santiago-Mora P, Skinner M, Hendricks A, Rimkus T, Meyer B, Gratzek J, Pu S, Woodbury L, Bond L, McDougal O. Pulsed electric field effect on acrylamide reduction and quality attributes of continuous-style Lamoka potato chips. Heliyon. 2024 June; 10(11):e31790-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2405844024078216 DOI: 10.1016/j.heliyon.2024.e31790

Certification:

I certify that the information provided is current, accurate, and complete. This includes but is not limited to current, pending, and other support (both foreign and domestic) as defined in 42 U.S.C. § 6605.

I also certify that, at the time of submission, I am not a party to a malign foreign talent recruitment program.

Misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§ 287, 1001, 1031 and 31 U.S.C. §§ 3729-3733 and 3802.

Certified by McDougal, Owen in SciENcv on 2025-02-19 18:06:07

Appendix C : Senior Personnel – Provide a description of qualifications and services expected from all consultants, visiting professors, postdoctoral associates, and other senior personnel.

Sara Dorland is the managing partner of Ceres, a consulting company providing techno-economic analysis to companies throughout the dairy and food processing supply chain. Dorland started Ceres in 2009, providing consulting services to multi-national companies, food processors, cooperatives, and others evaluating agricultural investments. Her analysis has guided the construction of several US processing facilities with others in the evaluation stages. Dorland has provided economic advice to Senator Schumer's staff for the Farm Bill, testified before the USDA relating to the Federal Milk Marketing Order hearings, and her expertise is critical to validating the activities and results obtained by the team for economics related to commercialization.

Dorland will conduct economic analysis for this IGEM HERC potato/oat starch/protein project. She will identify market trends and opportunities to advise the team to make decisions using the correct metrics to ensure practical solutions are generated from team activities. In addition, Dorland will conduct an in-depth economic and market analysis to support the research and commercialization of potato and oat protein/starch ingredients. The analysis will assess production costs, market demand, competitive positioning, and potential revenue streams to guide commercialization strategies and investment decisions to move from pilot to commercial scale. Key industry trends, regulatory considerations, and supply chain dynamics will also be evaluated to ensure project viability and market alignment. Dorland will receive $10,000 in year 1, $35,000 in year 2, and $5,000 in year 3 for a total budget request of $50,000.

Project Deliverables

Deliverable	Scope	Anticipated Delivery Date
• Economic feasibility assessment, including cost of production and potential return on investment • Market demand analysis for potato and oat protein/starch in food, feed, and industrial applications • Competitive landscape review, identifying key players and market positioning strategies • Supply chain analysis, including raw material availability and processing infrastructure • Regulatory landscape assessment, identifying compliance requirements and barriers to entry	Develop a business plan to summarizing findings and strategic recommendations for commercialization. Considering the following: • To better define the value proposition to customers • Provide financial impact review of new products/technology on customer's bottomline – whether revenue generation or cost avoidance. • For example, upcycle, review the cost of waste, energy, labor related to disposal of by-products or off-specification potatoes to determine	The delivery date will be contingent on other aspects of the project including plant design, throughput and other considerations. There would be consideration for grant schedule of delivery dates and presentation schedule.

• Final report	the value of new products	
Weekly meetings	Attend scheduled meetings	TBD
Update reports/provide as necessary	Project reports as needed	Monthly/quarter
Provide support for presentations – up to 8 per year	The deliverable will be to support the business development aspect of these presentations such as strategy, customer acquisition strategies for dairy clients, business plan development & review and financial statements (see earlier deliverable). Provide support to communications team and attend meetings to field financial questions and food processing specific knowledge and support.	The delivery dates will vary depending on the presentation schedule.

Catherine Cantley is the Director of Studio/Blu at Boise State University and a leader in TechHelp, a multi-institution resource to promote public private partnerships. Cantley's background is in food science, specifically sensory science. She has extensive experience in the potato industry, as a former Simplot employee, where she often organized expert sensory panels to evaluate food product quality and marketability. Cantley will organize, coordinate, and conduct sensory panels for Papa Latte formulations and oat-based extruded meat alternative products. Cantley anticipates on the order of ten panels, over a three-year period, where each panel consists of fifty participants each. She will develop consumer surveys, acquire feedback, and disseminate her findings to the team for product optimization.

Research Scholar – This new position will complement the work of PhD graduate student **Caleb Renshaw**. Renshaw is a former Simplot employee who will be responsible for processing potatoes into starch and protein ingredients at the FDIC at BSU. He will conduct functional and physical property evaluation for the ingredients, and determine the yield and quality of ingredient by refined protocols. The research scholar will primarily work in the Food Physics food grade reseach lab, where they will use the twin screw extruder for development of oat-based alternative meat products. The research scholar will also formulate Papa Latte using different plant proteins to prepare products for sensory panel evaluation. The research scholar and Renshaw will meet regularly with PI McDougal and IPP leaders, McFarland, Gillette, Salamanca, and Flores to optimize potato processing methods that lead to favorable returns.

Appendix D : Other – Provide documentation of other sector resource commitments including up to five (5) letters of support or private sector partnerships. Letters of support must explicitly describe the role(s)/ contribution(s) of the supporting partner in the proposed project.

The order of letters is as follows:

(1) Don McFarland – Genesis Organics
(2) Tom Gillette – Idaho Potato Products
(3) Kalen McKenzie – Food Physics
(4) Monte Quast – Gibby Group
(5) Dustin Nichols – Ingredion
(6) Loren Ward – Glanbia Nutritionals

Don McFarland
Genesis Organics
138 S Custer St.
Glenns Ferry, ID 83623
Phone: 208-731-2818

February 5, 2025

Subject: Letter of Support for Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses

Dear IGEM HERC Committee,

On behalf of Genesis Organics, I am pleased to provide this letter of support for the Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses. We strongly believe in the mission and objectives of this project and recognize the significant impact it will have on Idaho.

As a committed partner, Genesis Organics will contribute to the infrastructure and I will personally provide potato washing and sorting equipment for an in-kind match estimated at $2,000,000. Specifically, we will provide a warehouse building environment, utilities, potato washing and sorting equipment, and personnel time to create a potato processing operation that can operate 24 hrs./day, 7 days a week, for 365 days/yr. The equipment is sufficient to easily accommodate an input of 2,000 lbs. of potatoes per hour, and the space sufficiently suited for at least seven employees per shift for three shifts each 24-hr. day. Manny Flores and I will support the successful implementation and sustainability of the potato processing operation to generate starch and protein ingredients.

We look forward to working with PI Owen McDougal to ensure the successful execution of this project. Please do not hesitate to reach out if additional information is needed regarding our commitment.

Sincerely,

Don McFarland
Owner
Genesis Organics
camasorganics@gmail.com

Tom Gillette
Partner
Idaho Potato Products
433 S Highway 27
Burley, Idaho 83318
tdgtom@gmail.com
208-300-4000

February 5, 2025

Subject: Letter of Support for Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses

Dear IGEM HERC Committee,

On behalf of Idaho Potato Products, I am pleased to provide this letter of support for the Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses. We strongly believe in the mission and objectives of this project and recognize the significant impact it will have on Idaho.

As a committed partner, Idaho Potato Products will contribute an estimated $2,000,000 worth of potato processing equipment, including a rasper, centrifuge, cyclone, vacuum filter, and flash dryer. This equipment will complement the washing and sorting systems that Don McFarland will contribute to this project. I have sourced this equipment, and am prepared to purchase what we need to begin processing potatoes into starch and protein ingredients for consumer products. I work closely with potato growers and processors and know that I have commitments to obtain potatoes and I have customers for starch and protein to ensure the success of Idaho Potato Products. I have started new businesses in Idaho and I have worked with Don McFarland, Manny Flores, and Mauricio Salamanca for many years.

We look forward to working with PI Owen McDougal, PhD to ensure the successful execution of this project. Please do not hesitate to reach out if additional information is needed regarding our commitment.

Sincerely,

Tom Gillette
Idaho Potato Products
tdgtom@gmail.com

Kalen C McKenzie
General Manager / Partner
Food Physics
8512 Elisa Street
Boise, Idaho 83709
kalen.mckenzie@food-physics.com
440-732-5083

February 5, 2025

Subject: Letter of Support for Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses

Dear IGEM HERC Committee,

On behalf of Food Physics, I am pleased to provide this letter of support for the Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses. We strongly believe in the mission and objectives of this project and recognize the significant impact it will have on Idaho.

As a committed partner, Food Physics will contribute office and laboratory space at 8512 W Elisa St Boise, ID 83709. Specifically, we will provide office space at a monthly cost of $500 and food grade laboratory space at $7,933.50 per month. We have an agreement with Boise State University for Dr. McDougal to locate and operate equipment in this food-grade space for this project. The in-kind match that we have committed to this project is $101,202 per year.

We have worked with PI Owen McDougal for the past five years on more than six sponsored projects associated with the application of pulsed electric field technology for food and beverage, including grapes/wine, barley/malt, dairy, biomass and potatoes (i.e., fries and chips). We look forward to contributing to this IGEM HERC award to ensure the successful execution of this project by provided a research site for pulsed electric field, extrusion, and development of potato starch and protein containing consumer products. Please do not hesitate to reach out if additional information is needed regarding our commitment.

Sincerely,

Kalen McKenzie
General Manager/Owner
Food Physics
kalen.mckenzie@food-physics.com

GIBBY GROUP

SINCE 1944

134 East Highway 81 Burley, Idaho 83318 ❖ phone 208-654-2733 ❖ email office@gibbygroup.com ❖ fax 1-866-917-2553

Monte Quast
CEO
Gibby Group
134 E. Hwy 81
Burley, Idaho 83318
monte@gibbygroup.com
208-312-3221

February 10, 2025

Subject: Letter of Support for Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses

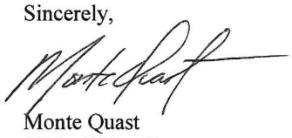
Dear IGEM HERC Committee,

On behalf of the Gibby Group, I am pleased to provide this letter of support for the Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses. We strongly believe in the mission and objectives of this project and recognize the significant impact it will have on Idaho.

As a committed partner, the Gibby Group will provide oat pulp to PI McDougal for the development of oat-based alternative meat consumer products. We are committed to providing the best value to our customer, Chobani, to return value in their oat pulp byproduct.

We look forward to working with PI Owen McDougal, PhD to ensure the successful execution of this project. Please do not hesitate to reach out if additional information is needed regarding our commitment.

Sincerely,



Monte Quast
CEO, Gibby Group
monte@gibbygroup.com

Ingredion Incorporated
5 Westbook Corporate Center
Westchester, IL 60154
United States

January 27, 2025

Owen McDougal, Ph.D.
Dept. of Chemistry and Biochemistry
Boise State University
Office: MCMR 210-D
1910 University Drive
Boise, ID 83725-1520

Dear Dr. McDougal,

Ingredion Incorporated, a Delaware corporation with offices at 5 Westbrook Corporate Center, Westchester, IL 60154 ("Ingredion") would like to offer this letter of interest ("LOI") to express our general interest in the proposal and development of '**Potato protein and starch extraction and purification for the purpose of animal and human grade ingredients and products'**. This letter is not a binding agreement; it merely expresses the company's general interest.

Each party will bear its own expenses to research the quality and evaluate the market value for the protein and starch produced by your team; Ingredion will bear no financial responsibility, but will provide in-kind ingredient assessment. Our understanding is that the potato protein for human consumption portion of the research project will be funded by grant money from the Idaho Global Entrepreneurial Mission Higher Education Research Council (IGEM HERC) program. Each party will use their own expenses for continued evaluation of protein and starch ingredients.

- Nothing in this LOI shall be construed as a promise by Ingredion to enter into an agreement, and Ingredion may elect to terminate its research and evaluation at any time for any reason.
- In the event that this research program does not result in the parties entering into an agreement, neither party shall have any liability to the other party based upon this LOI.
- Except as required by law, the university shall not publicize or share Ingredion's interest into this project. Publicization of Ingredion's interest or support shall require Ingredion's review and written approval.

Sincerely,

Dustin Nichols

Dustin Nichols
Associate Manager, Potato Supply

Glanbia Nutritionals
450 Falls Avenue, Suite 255
Twin Falls, Idaho 83301
Phone: 208 735 4700
www.glanbianutritionals.com

February 10, 2025

Owen McDougal, PhD
Professor and Chair, Department of Chemistry and Biochemistry
19110 University Drive, MS 1520
Boise State University
Boise, Idaho 83725

Subject: Letter of Support for Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses

Dear IGEM HERC Committee,

I am pleased to provide this letter of support for the Upcycling of Potato and Oat Byproducts to Promote Economic Returns for Idaho Businesses. We strongly believe in the mission and objectives of this project and recognize the significant impact it will have on Idaho.

Glanbia Nutritionals does formulation work across the food industry and is interested in protein and fiber-based ingredients. These novel ingredient could be utilized in food formulations. Glanbia Nutritionals will evaluate potato fiber, starch and protein ingredients and recommend consumer product alignment and modification protocols to ensure the ingredients achieve their optimal market valuation. Specifically, we will provide bench top evaluation for ingredient taste, functionality and suitability for food applications. This will help support the overall mission to upcycle byproducts into useful ingredients that will benefit the state of Idaho, Idaho business and environmental and sustainability efforts.

We look forward to working with Owen McDougal, who is the Principal Investigator, to ensure the successful execution of this project. Please do not hesitate to reach out if additional information is needed regarding our commitment.

Sincerely,

Loren S Ward, PhD
Chief Innovation Officer
Glanbia Nutritionals

Better nutrition, built around you.