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RESEARCH ARTICLE

Increasing Pulse Foods in the Human Diet: A Qualitative Study

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ABSTRACT

Pulse foods are by definition the dry edible seeds of the botanical family *Leguminosae*. They include the common bean, chickpeas, lentils, and dry peas. The history of pulse use is briefly explored to illustrate the long and varied human traditions of pulse use through the centuries. Nutritional benefits include high protein, fiber, vitamins, and minerals. Pulses have also been studied for their positive effects on a number of chronic human health issues, such as cancer, diabetes, heart disease, obesity, blood pressure, and cholesterol. A description of pulse crops and their place in the agricultural environment illustrates how they are necessary for sustaining soil health, along with patterns of production and consumption worldwide.

Health benefits of pulse foods consumption have been well established in the literature, but consumers remain reluctant to use them. The Dietary Guidelines for Americans as well as the Food-based Dietary Guidelines in Europe recommend at least two times weekly up to daily consumption of pulse foods, yet the vast majority of people fail to meet these minimums. In order to understand more fully the barriers to pulse consumption, a qualitative study was conducted by interviewing seven professionals who work with pulses across the spectrum of education, commodity organizations, research institutions, farming, and Cooperative Extension within a pulse-growing region of the U.S. Qualitative interviews using structured questions were conducted via Zoom with selected participants. A series of ten semi-open-ended questions were asked, including personal consumption habits of pulses, new pulse products on the market today, how the word "pulses" is understood or misunderstood by consumers, nutritional benefits, the role of MyPlate in helping consumers to plan meals with pulses, the types of consumers who eat pulses the most and what pulses they choose to eat, barriers to pulse use, and solutions for increasing and promoting pulse consumption. Data analysis found that there were a variety of reasons for the reluctance to use pulses, as well as the difficulty in marketing, research, and increasing production of pulses. Some solutions for promoting pulses could be implemented in the near future, and other solutions needed further research to implement.

Keywords: pulses, beans, legumes, plant-based, nutrition, diet, health, Extension, commodities

Introduction

Legumes have long been established as a healthful food, but the problem of underconsumption remains. In the U.S., production of pulses is 2.9 million tons annually, although consumption remains relatively low.[1] In fact, U.S. consumption is so low that to meet the Dietary Guidelines for Americans (DGA)[2] consumers would have to eat five times what they are currently eating to meet that goal in a 2000/kcal/day diet.[3] U.S. promotions of pulses, such as National Bean Day and National "Eat Your Beans" Day is not having the effect that was hoped.[3]

The DGA recommends consuming 1.5-cup equivalents per week in a 2000-calorie a day diet, yet the National Health and Nutrition Examination Survey (NHANES) 2004-2014 reports that these consumption levels remain consistently low.[4] Food-based dietary guidelines (FBDG) in Europe[5] are widely ranging depending on the country, with a number of countries suggesting no minimum amount, while Spain sets the recommended frequency at 4 times per week, with the goal of daily consumption. Some qualitative suggestions in the FBDG include replacing meat with pulses in some countries; in others, simply adding pulses to the diet.[5] Some researchers suspect the reasons for low pulse consumption are related to consumer issues, such as lack of knowledge, bad memories of beans in school lunch menus, canned beans perceived as 'poor people's food,' perception that they're difficult to prepare, lack of ideas on how to cook them palatably, or just a lack of motivation.[6]

In order to better understand the forces behind consumer shortfalls in including more pulses in menu planning and consumption, we begin by defining pulses; tracing their history and culinary traditions; listing nutritional and health benefits of pulse foods; underlining the importance of pulse crops, production and consumption in the trajectory of farm to table; and finally, exploring directly some solid factors that influence lack of consumption along with potential solutions by interviewing seven pulse professionals in a pulse-growing region of the U.S.

Definitions

Pulses by definition are the **dry edible seeds** of the botanical family *Leguminosae*.[4] We know these dry edible seeds most commonly as **beans, peas, and lentils.** Some examples of species in this family include common bean, chickpea, lentil, fava bean, mung bean, soybean, common pea, pigeon pea, black-eyed pea and lima bean. Some examples of the common beans' cultivars are kidney, black, cannellini, pinto, pink, great northern, cranberry, mayocoba, white, navy, yellow, purple, and turtle. In summary, dry edible beans, peas, chickpeas, lentils, and others listed above are all pulses, and all pulses are included in the larger family of legumes.

Legumes include other types of varied plants that may or may not be edible for human consumption. One well-known example is soybeans, where some crops are grown for oil used in either food or commercial applications. If soybeans are used for food, such as tofu or tempeh, they are considered pulses. Examples of legumes that are not pulses but used as food are peanuts, which are not a "nut" but a legume, and fresh green beans and fresh green peas, in or out of the pod, which are considered fresh vegetables in human food nomenclature. Other legumes not used for human food consumption include alfalfa and other agricultural crops used for ground cover, forage, or livestock feed applications.[7]

History and Tradition

Pulses are ubiquitous in human cultures across time and space. Even though the botanical family *Fabaceae* (alternatively, *Leguminosae*) groups together beans and peas in that they all have pods, the number of ways we have used pulses are quite varied:

- dried for storage, then cooked
- eaten immature and fresh
- ground into flour and made into breads and pastas
- specifically, soy is processed into milks, tofu, soy sauce, miso, and oil
- used as spices and condiments.[8]

As far back as we can trace the record of human civilization, we have been cultivating and eating pulses for at least 11,000 years. Some of the oldest evidence comes from Egypt and Thailand. Almost every culture uses pulses as the base of their cuisines; for example, in the southern U.S., black-eyed peas are popular; in India, lentils; in South America, black beans; and in the Middle East, chickpeas.[9]

The Three Sisters tradition of growing maize (corn), beans, and squash in the Americas was practiced and perfected by the Wyandot women, known as the Huron nation so named by the French, among other tribes. This practice began by mounding fish waste every three to four feet, covering that natural fertilizer with soil, then planting corn in the middle. When the corn was a few inches high, beans would be planted around the corn. Squash would be

planted between the mounds. The result of this combination is that the nitrogen-hungry corn is fed by the nitrogen-fixing beans, which in turn need the cornstalk to support its vine structure, and the broad squash leaves provide ground cover.[10]

In Europe, dried and fresh beans and peas were imported from Holland until the late 1600s, when they were cultivated locally. In England, pease porridge was common in households, thus the nursery rhyme "Pease porridge hot/Pease porridge cold." The explanation for this bit of folklore is that the porridge was constantly brewing in a large iron pot near the fire, and as it was served and eaten, more peas and kitchen scraps were added to the leftover porridge in the pot to create a constant, bubbling supply. In France, the royals could not get enough of their pulses. In a few decades, they were consuming haricots vert (green beans), white beans in casseroles, and red lentil puree. And in Germany, people were eating their dried beans cooked with cured pork.[10]

We usually think of the Mediterranean diet as something new, but it actually evolved over millennia in the countries and various regions surrounding the Mediterranean Sea. Not only was this diet, heavily reliant on pulses, considered a "poor man's diet," but it also developed through observation of religious rituals, which dictated fasts from meat and other animal products at various times throughout the religious calendar. Pulses are high in protein and other nutritious substances, so were an ample and delicious substitute during these fasting periods. Many soups in the region contain white beans as the base, including those from Italy, Greece, Cyprus, and Turkey.[11]

Pulses have been cultivated for thousands of years, and provide high nutritive value for the human diet. Many countries and areas of the world have relied on pulses in their daily cuisine and traditional food culture. Some modern examples of traditional uses of pulses include their appearance in salad, soup, pilaf, or mixed with meat. Chickpeas, one of the most popular pulses today, are roasted and eaten as a snack, though the idea originated in Turkey and spread from there. Falafel consists of ground chickpeas or fava beans rolled into balls and deep-fried, and hummus is a revival food that consists of blended chickpeas made into a spread.[12]

Nutrition and Health Benefits

Pulses provide the best nutritional value among vegetables. Researchers listed many reasons to consume legumes, including high nutritive value (protein, fiber, complex carbohydrates, iron, zinc, B vitamins, and essential amino acids), no saturated fats, and a major protein food source that is inexpensive, widely available, and sustainable.[3,13,14] Pulses are high in protein, and developing nations consume most of their protein from vegetable sources; therefore, pulses can supply this necessary macronutrient. They are higher in protein than most cereal grains, such as rice and wheat; however, pulses and grains complement each other in providing a complete protein because pulses are limited in the amino acid methionine and grains, in lysine.[15] Pulses are also low in fat and high in fiber, which results in a low-glycemic index, as well as promoting digestive health and heart health.[16,17]

Increasing fruit and vegetable intake, along with whole grains, beans, nuts, and seeds, has been established through research as the road to better human health.[18] Pulses are important in improving health outcomes for glycemic control, blood pressure, cholesterol, inflammation, and weight management.[13] Among those with type 2 diabetes, improving dietary intake of foods high in dietary fiber is crucial because these individuals are personally responsible for providing up to 95% of their own care as they go about their daily lives.[19] Further, research suggests that fiber in pulses promotes high satiety and reduced appetite.[4,20]

Pulses are known for their positive effects on other chronic conditions such as hyperlipidemia, metabolic syndrome, type 2 diabetes, coronary heart disease, and hypertension.[21-24] Eating pulses long-term can affect risk levels of some cancers, help with blood sugar levels, and control appetite in weight management.[4,25] Longevity is also associated with increased consumption of legumes across cultures and across pulse types.[26] Legumes also contain anti-nutritional components such as enzyme inhibitors, phytic acid, tannins, and lectins.[27,28] These can inhibit the absorption of the nutritional factors; however, anti-nutritional components have been shown in other research to aid in inhibiting the processes of chronic disease such as cancer.[29]

Pulse Crops

Highly implicated in sustainable agriculture, pulse crops are well situated because of genetic diversity along with their nitrogen fixing attributes. Nitrogen-fixing means that pulses take nitrogen from the atmosphere and fix it into the soil, reducing the need for chemical fertilizers, which reduces greenhouse gases, promotes carbon sequestration, and reduces soil erosion. To mitigate climate change in food production and price stability of agricultural commodities, pulse varieties could be selected and developed for their climate-resistant properties.[16] Further, nitrogen helps to minimize algae blooms

that are a result of fertilizer run-off in still bodies of water, as well as emissions of nitrous oxide and carbon dioxide in the atmosphere. Because synthetic nitrogen fertilization has high energy costs and is responsible for over half of all energy used, the natural production of nitrogen by growing legume crops is of utmost importance.[30]

Pulse consumption is important in feeding the world. 2016 was designated the International Year of Pulses by the United Nations General Assembly in order to address food security and sustainability throughout the globe.[31] Pulse crop cultivation produces low greenhouse gas emissions and has a low water consumption footprint, as well as enriching the soil by fixing nitrogen.[3] As we move forward through the 21st century, the Food and Agriculture Organization of the United Nations (FAO) recommends we find solutions to two key issues: meeting nutrition needs of the global population, and meeting agricultural needs in a sustainable way.[16] These issues viewed together address the situation of food insecurity, which is "characterized by the lack of access to safe, affordable and nutritious food".[16]

Production and Consumption

Currently, the most produced types of pulses globally are common bean, pea, chickpea, cowpea, and lentil.[1] The top pulse-producing nations globally are India and Canada, with China in fourth place, and the U.S. coming in at ninth. Turkey and Mexico are in thirteenth and fourteenth place, and France and the U.K. following in seventeenth and eighteenth according to data compiled by the FAO from 1961-2019 in metric tons.[32] However, other data indicates that while pulse acreage is increasing steadily over recent years, pulse yields have not improved. If people were consuming the recommended levels for dietary health, current pulse production would not meet these needs. Further, with the fast-growing plant-based meat alternatives market well-established, by 2030 pulse production is projected to fall behind demand.[33]

When deciding what to eat, consumers don't think of pulses because that particular food may not be on their radar. Generally, we found that in our region of the U.S., meals and grocery shopping are planned in terms of meat and starch, then vegetables or fruit as side dishes or enhancements. Many recipes that do include pulses have them as an option, where they may be left out and the recipe will still work.

In consideration of the personal, agricultural, and global health and sustainability benefits, researchers continue to strive to ascertain obstacles which stymy promotion of personal pulse consumption. To determine which obstacles are most pressing, as well as discover possible solutions, we set out to interview professionals who work in the areas of pulse research, production, education and promotion in our particular pulse-growing region of the U.S.

Study Purpose and Design

The purpose of our study was to gather local and regional expertise to gain a more intimate view of barriers to and solutions for increased pulse consumption. Our aim was to compare previous research literature to what we found in the present study regarding barriers and solutions, then ask current pulse professionals their opinions regarding the most pressing questions. As we live in the midst of a prime pulse-producing region in the U.S.—Montana, North Dakota, and Minnesota—we had access to professionals working in the pulse field, and wanted to tap that resource of professionals and their vast knowledge and experience.

As a qualitative study, we interviewed several professionals across a subsection of the pulse industry to cover a range of opinions, keeping the number of participants low in order to get breadth and depth of opinions and experience from the interviews. As a pulse professional in education, co-author Garden-Robinson was able to reach out to a number of colleagues who agreed to be participants themselves or helped us identify potential participants of their acquaintance. We interviewed seven professionals in all, representing education, agricultural commodities, production, research, and Cooperative Extension. All interviews were conducted by co-author West, who had only a passing acquaintance with one of the participants; all others were previously unknown. This allowed for more candid results as well as objectivity in design.

Interview Questions and Results

Interview questions were informed by literature on the use of pulses by professionals in the industry, new pulse-based products, the word 'pulses', pulse nutrition, the DGA in the form of MyPlate[34], populations that eat pulses the most and least, barriers to getting consumers to eat more pulses, and solutions to these barriers, along with promotion of pulses, such as what worked and could be expanded upon, and possible areas to open up for the future of pulse consumption (and production in some cases). See Table 1 for a list of the question categories that were generated for use in the interviews. Ten question categories were developed.

Table 1. Interview questions from our study.

Interview Question Categories
1. Background and interest
2. Personal use of pulses, past and present
3. New pulse products you've heard about or tried
4. Terminology
5. Nutritional benefits
6. The role of MyPlate[34] (Dietary Guidelines for Americans[2])
7. Who eats pulses, and which pulses do they eat
8. Biggest obstacles to getting people to eat more pulses
9. Promotion of pulses
10. Final thoughts

The bulk of the interview results pertained to obstacles and barriers to pulse use and suggestions for promoting pulses and providing solutions to some of the obstacles and barriers noted from the transcript. Since some of the participants were from commodity groups as well as actual producers of pulse crops, some barriers and solutions reported pertained to pulse production more so than to pulse consumption. These points were noted along with personal eating patterns of pulses.

1. BASIC BACKGROUND AND INTEREST IN PULSES
For the first question category, we asked participants for their position and role, whom they serve and in what capacity, and general background they wanted to share. We also asked why they chose to work with pulses and their interest in them.

2. PERSONAL EXPERIENCES OF PULSE FOODS
Research found that persons in the food and nutrition professions, such as Cooperative Extension agents and educators, public health educators, school food consultants, and dietitians, reported having pulses frequently in their meals at home and with family, as well as regular pulse choices when eating out.[31] To follow, we asked participants to remember their childhood memories of eating pulses, and how they got started eating them. Which pulses did they like best or worst, and why? If participants had memories of favorite recipes, we asked to mention them as well. Not all answers were limited to childhood experiences, as some participants began to eat more pulses during the college experience, or as adults raising families of their own.

Interviewees reported personal memories of pulses growing up in the form of canned beans; basically, the pork and beans and baked beans products seen most commonly in every grocery store; even convenience stores stock them. Other pulse meals were made using grandma's bean or split pea soup recipe, or Tex-Mex style in bean burritos or as an ingredient in homemade chili (usually a bean and ground beef tomato-based soup, sometimes not even including chili peppers as an ingredient). Cowboy caviar, a type of bean, corn, and bell pepper salsa that is dipped into with corn tortilla chips, or three-bean hotdish (entrée that is a mixture of ingredients), made with kidneys, navy beans, butter beans, and bacon and ground beef were other local favorites. Some participants listed hummus as a common pulse-based snack, and chickpeas and other cooked and chilled beans one may find on a salad bar.

3. NEW PULSE PRODUCTS
The use of pulse flours has increased in recent years, evidenced by the higher occurrence of these products on food labels in the form of pulse flour, pulse protein, and pulse starch.[1] Pulse flour can be used by the food industry to create quick breads, tortillas, pastas, baked goods or desserts, crackers, and of course meat analogues.[1,35,36]

Research points out that the gluten-free market is continuing to increase, and naturally gluten-free pulses are available with higher protein content and overall nutrition than more common gluten-free foods that are usually made from low-protein, highly-refined-carbohydrate substances from corn, rice, and potato.[12] These product formulations are in continual development and modification for their importance in increasing food supply with highly nutrient dense foods, in particular pulses, because of their low cost and sustainability in agriculture. Getting protein content just right for best nutrient absorption while maintaining texture and palatability of these new foods is an ongoing challenge.

Recent developments in food manufacturing have taken advantage of legumes' unique food chemical

properties of solubility, water binding capacity, fat binding, emulsification, and foaming to make "milk" products and more popularly pasta products.[30] However, these items are still only a niche market and purchased as a replacement for those consumers who do not tolerate milk and wheat well. Thus, the consumer still perceives legumes as marginal to their culinary habits.[30] We wanted to know from our participants where these developments were heading and their opinions on the future of value-added pulse use in food manufacturing.

Participants mentioned some of the most commonly found pulse-based products, such as pastas, chips, and crackers, as well as the newer meat-alternative pulse 'burgers' and 'chicken nuggets.' Pulse proteins can be found in a variety of foods, and folate may be fractionated from pulses for increased nutrition in manufactured foods. One participant mentioned the current research in using pulse fiber to make clothes. Others emphasized the aspect of consumers following a gluten-free diet and the marketing of pulse products to fill that niche. Finally, one participant noted that it is so much cheaper to just buy beans in bulk and cook them for meals, yet more consumers are apt to purchase the more expensive processed foods made from pulse flours and proteins.

4. THE WORD 'PULSES'

Among researchers and educators in the field of pulses, the term 'pulses' is commonly used, along with the phrase 'dry edible beans.' However, among the two representative commodity groups in our region, these terms are not interchangeable; indeed, they have their own distinct designations. Even though all dry edible beans and peas are all pulses by scientific definition, 'pulses' are defined by the 'pulse' commodity group in our region as *only* lentils, chickpeas, and peas; and 'dry edible beans' (any pulse *not* a lentil, chickpea, or pea) by the 'bean' commodity group in our region.[31] However, research indicates that chickpeas, dry peas, and lentils have different growing conditions, growth structure, and maturation than the other dry edible beans.[37]

If the goal is to promote more pulse consumption among the general public, this confusing terminology coming from the research and commodity groups might be considered a possible barrier. To find out more about the history of this division, and how it might be bridged, we asked this question of our participants to clarify the situation, and get opinions as to how it may be remedied, if it needs to be at all.

In the past, the term 'legumes' was commonly found in cookbooks, and sometimes referred to individual beans or peas, but more recently the term 'pulses' is used in research and education. Co-author West found herself having to use both the terms 'pulses' and the phrase 'dry edible beans' when speaking to interview participants, especially those in the separately represented commodity groups, to make sure the questions were understood to mean both, and that the term pulses is inclusive of all dry edible beans, peas, and lentils (although the term 'beans' is not inclusive of dried peas, lentils, and chickpeas in regional commodity group language). That said, the results of this question category showed alternating terminology as an obstacle to pulse promotion.

One participant was able to relate the history of how this happened, at least in the pulse growing region of this study. Beans, that is, everything but dried peas, chickpeas, and lentils, were grown locally (North Dakota and Minnesota) much longer before 'pulses' (dried peas, chickpeas, and lentils) came on the scene. Washington and Idaho western U.S. states were growing 'pulses' while our north central region focused on 'bean' crops, which were represented by a bean commodity group.

When North Dakota and Montana started growing 'pulses' as well as 'beans,' a new commodity group was formed to represent those crops (late 1990s), which also included fava beans and lupins (in addition to dried peas, lentils, and chickpeas). The split happened because in our region one commodity, beans, was in production long before the "newer" pulse crops came along, and the addition of these "newer" crops would have been too much for one commodity group to handle, thus, a separate pulse commodity group was formed, representing producers in Montana and North Dakota. The bean commodity group was still in charge of North Dakota and Minnesota producers. Producers in North Dakota grow both pulses and beans, so are represented by both commodity groups.

Further, relates this same participant, this split was carried over into research groups in the local universities, so the terminology within research uses the two different terms as well, matching that of the

commodity groups. The term 'pulses' was further promoted with Canadian and other international commodity groups, and with 2016 ushering in the International Year of the Pulses, the term 'pulses' stuck and is here to stay. However, consumers have not grasped the term 'pulses' in referring to dry edible beans, peas, and lentils.

At the end of this participant's exposition, they ended up questioning their own understanding of the terminology, stating "soybean is considered a pulse as well, or are they a legume, how does that work, because alfalfa is actually a legume?" The point is, if a commodity professional has difficulty with the differing terminology between pulses and beans, how much more difficult is it for the lay public to understand what they come across in education, research, and marketing? And how much does that misunderstanding contribute to obstacles in promoting pulses? Further, the pulse grower we interviewed stated that "edible beans is not a pulse crop" (this farmer grows edible beans but not lentils, peas, or chickpeas) because their understanding of the distinction follows that of the commodity groups that serve the regional growers.

The Extension professional interviewed stated that they must list pulse foods separately when working with consumer-clients, and that even though the word 'legumes' was used more frequently in the past, they now must change the terminology to match what is happening with commodity, research, and international organizations. Ultimately, they said, it is easier just to list or refer to the different individual types of pulses (e.g., kidneys, black, lentils, split peas) when working with clients than to use the word 'pulses.'

5. BENEFITS OF PULSE NUTRITION

Nutrition and health benefits of pulses are well established in the literature and among the U.S. DGA[2] and the European FBDG[5]. We wanted to know how our study participants understood these benefits themselves and in their own professional lives working with pulses. For the Extension and educational professionals, human nutrition was foremost, but with those we interviewed in the more agricultural side of things, nutrition involved the health and sustainability of the soil as well. For example, one participant stated that producers are "looking to soil health and the use of brassicas, snow catch and moisture catch; just a change of mindset lately that's been a help to the industry; it's nice to grow corn and wheat into last year's edible bean ground." Those interviewed understood this as a nitrogen-fixing attribute, as previously discussed. In that sense, some participants revealed that pulses are both healthy for the soil as well as important for human health (and livestock feed, as reported in interviews).

6. MYPLATE AS A CONSUMER GUIDE

Participants were prompted to respond to the occurrence of pulses found in the two separate categories of the MyPlate[34] guidelines. Most found that it was beneficial in promoting pulses to show consumers that they count for the protein category as well as the vegetable category, making it easier and more versatile to fit into meal planning. One participant used the word "flexibility" and that because of the two categories, people have "more options, people can flex it." A pulse researcher participant stated that protein was the most important of the two categories in the view of worldwide nutrition. Another participant stated that "once people understand that they count as [both] vegetable and protein, they may tend to think of pulses as a superfood."

7. PULSE-EATING POPULATIONS AND TYPES OF PULSES EATEN

Research has illustrated cultural and geographic characteristics of a variety of pulses among a variety of consumers. Researchers at Johns Hopkins University aimed to understand the types of consumers who eat pulses currently (and robustly), and what types of pulses they are eating, by U.S. state and region, as well as season.[3] Using the NHANES along with retail scanner data, the 31 U.S. states measured revealed that the top five pulses consumed in the U.S. are pinto, black, kidney, lima, and chickpea, in that order. After the top five comes value-added pulses, such as canned beans, then great northern, lentils, black-eyed peas, and soybeans, in descending order.[3] Further, higher intake was noted for Hispanic cultures, larger households, and consumers with higher levels of education. These findings sometimes conflicted with a 24-hour recall data set which indicated that higher intake of pulses occurred among *less*-educated consumers, although the prevalence of lower income consumers was found in both data sets.[3]

We wanted to know who participants thought ate the most pulses and what types of pulses they ate. When we asked this question, we were prepared for any type of classification of consumers, whether

it be culture, age, income, education, or any other factor our interviewees divulged. We tried to leave the question open-ended, so that the results would be revealing, along with helping to determine a targeted audience in possible promotional campaigns.

Some of the data in this category matched previous research,[3] but answers were quite varied across our seven professional participants. Some responses seemed based on experience backed up by data, and others were informed opinions. Types of consumers ranged from ethnic groups to demographic categories. We also asked participants what types of beans these consumers were eating, but the question was either lost in the answering, or was answered separately (not correlated with any specific pulse-eating population). As such, both answers were tabulated but not correlated. See Table 2.

Table 2. Pulse consumers and types of pulses eaten (not correlated), from our study results.

Consumer Types

Cultural – Ethnic	**Cultural – Health**	**Age**	**Income**	**Education**
Hispanic/Mexican, in Mexico a way of life	More adventurous, open	20-30-year-olds; 30s decade	Higher income; access to high-end restaurants	Higher-educated
Specific developing nations making Section 32 purchases	Like trendy things, i.e., environmentally friendly, plant-based, no chemicals, sustainability, knowing where food comes from	People raising kids looking four healthy snacks; young moms	People who take what they can get on food relief programs	
Europeans – 16 oz/day (U.S. 4-5 ½ oz/day)	Hyper-focused/hyper-health conscious	Gen-Z-ers who are health conscious	Food insecure – pulses are cheap	
Southern states wrapping up around the Carolinas	Savvy consumers who see nutritional value	Age 40 and up not eating pulses unless they grew up with them		
Other cultures & ethnicities eat multiple times/day	Young people growing up in a more diverse culture			

Pulse Types	**Reason**
Black beans	Local consumption high
Pinto	Hot commodity
Navy	Hot commodity
White beans	Specialty niche
Great northern beans	Specialty niche
Chickpeas	Super popular

8. BARRIERS AND OBSTACLES

Some barriers to pulse use have been identified in the literature. Researchers noted obstacles such as the time it takes to prepare and cook, lack of knowledge on how to cook pulses,[1] and the digestive troubles (gas and bloating) that may sometimes result from eating pulses.[1,3,14,21,28] Another obstacle included pulse foods not being a part of consumers' traditional diet.[3,12,38] Barriers to using pulse flours include flavor (too beany) and texture (too grainy).[1,3,38] Other barriers noted were knowledge gaps of educators among dieticians.[39] Our open-ended question to our participants sought to find out more specific barriers or obstacles to

pulse use regionally as well as generally, especially in lieu of the questions previously discussed during the interviews. Data from the interviews resulted in five categories of obstacles to consumer use of pulses: cooking, cultural, marketing, research, and production. These categories seemed to correlate with the areas of specialization of each of our pulse professionals: Extension, education, commodities (including marketing), research, and production. See Table 3 for a summarized list of the various obstacles to pulse use.

Table 3. Obstacles to pulse use, from our study results.

Cooking Obstacles	**Cultural Obstacles**	**Marketing Obstacles**	**Research Obstacles**	**Production Obstacles**
Lack of knowledge on preparation, cooking, incorporating into menus, etc.	People don't know food provenance, even when grown locally	Terminology is confusing	Takes 12 years from developing new line to marketplace	Harder to grow
Where to find in grocery store	Don't grow up with them	Niche market	Need research to make them easier to grow with higher yields	Need different equipment and chemicals than popular crops (corn/soy/wheat)
How to make taste good	Family members stubborn to try them	Not found on restaurant menus (except for Mexican places)		Pulses for livestock feed not as reliable product as regular feed
How to prepare	Commodity culture wars	Texture grainy, taste bland		
Grocery store lack of display	Veggie burgers un-American	One bad experience, won't try again		
Lack of time	Reverse stigma; if healthful don't want to eat	Products made with pulses can be more expensive		
Implementing in schools slow process	Change is slow	Need to try before purchasing		
Long shelf life; don't get used		Not part of common menu planning		
Some varieties more difficult to plan menu (lentils)				

9. Solutions and Promotional Suggestions

Although there are some suggestions listed in the literature for promoting pulses and increasing their consumption,[1,3,4,15,19,30,37] we strove to find more local and regional solutions that might be employed in our area, although the questions were open-ended to allow for any type of promotion through whatever means might be available. We refined the line of questioning in this category more specifically when needed during the individual interviews, such as "Is it important to encourage more pulse use? Why?" and "How do we get people to eat more pulses? How do we get out the message?"

The basic question in this category purposed increasing pulse use; however, we found responses to this question (along with the obstacles question category) throughout the interview sets. In some cases, participants responded directly to stated obstacles with a solution to that obstacle, and in other cases they had general ideas for promoting pulses through education, Extension, or marketing. As such, we grouped the responses as actions stakeholders could take in their communities today, and as solutions to specifically stated or implied barriers, usually involving either more research or extended consideration to implement in the future. See Table 4 for a summarized list.

Table 4. Promoting pulses and solutions to obstacles.

Actions for Current Promotion	**Ideas for Future Development**
Place pulses in fruit and vegetable departments in grocery stores	Consider consumers' perceptions of pulses
Produce "quickinars" on pulses	Ride the wave of other trends, i.e., ancient grains
Use professionally produced social media, i.e., TikTok, YouTube, etc.	Use in flexitarian meal promotion
Get pulses on restaurant menus	Replicate hummus success story with other pulses
Run children's gardening programs	Focus on a younger audience to normalize eating pulses; use "pester power" to influence adults
Put pulses in trail mixes and other snacks	Collaborate with other pulse organizations, i.e., commodity groups, processors, retailers, etc.
Host special dinners with accompanying recipes to take home	Promote with gluten-free and weight loss diets
Allow pre-made pulse snacks in school lunch programs, i.e., pulse chips, PeaTos, etc.	Manufacture and stock 'missing' canned pulses, i.e., lentils, chickpeas, etc. for grocery retail
Make and disseminate infographics	Develop local "Made in the Midwest" campaigns
Link up pulse websites, i.e., Extension, commodity groups, etc.	Develop and produce ready-made pulse meals
More education through cooking instruction and demonstrations	Continue programs of outreach, education, and information
Develop recipes using pulses in desserts, as well as pulse flours in baking	Develop upright varieties of pulses for easier harvesting
Work directly with food banks in disseminating recipes, etc. for highly donated pulse foods	Increase production in pet food and livestock feed
Work with local snack manufacturers to make an inexpensive local version of pulse snacks, i.e., Barrel of Fun®'s success with a local potato chip	Work with beef and pork industries to bridge the culture war gap
Develop smaller programs and projects for a local audience	Develop freeze-dried products for school lunches
Develop pulse programming with senior centers and faith centers	Increase fractionated pulse industry products, i.e., clothing made from pulse fiber, ACE-inhibitory peptides,[40] folate, etc.
Put on regional harvest festivals that focus on pulse foods used in a variety of ways, i.e., National Lentil Festival in Pullman, Washington	Market pulse products using names of individual pulses; i.e., pintos, split peas, lentils, kidneys (and discontinue use of word "pulse" at consumer level)
Host recipe contents, i.e., chili cook-offs, etc.	Develop pulse profiles for each individual pulse for USDA-approved ingredient market
Implement retail programs with grocery and other outlets for promoting pulses with end-cap features, tear-off recipes, shelf-talkers, locally-produced sections, etc.	Promote recipes to dovetail with latest kitchen equipment, i.e., Instant Pot®, etc.

10. PARTICIPANTS' FINAL COMMENTS AND SUGGESTIONS

Besides final comments, we also asked, "What do you hope comes from this study?" as well as any final recommendations participants had for promotion of pulses, or to emphasize any points during the interview they wanted to make sure we did not miss. Participants reiterated that anytime we can learn something about pulses is positive for "pushing the research, marketing, and production agendas," along with helping people to improve dietary habits.

Further, participants realized there is a shift happening towards being more open about the provenance of our food, and "from a sustainability standpoint, the world market is looking at carbon scoring, so pulses rate well" on that front, which includes a "much larger role in global food production." However, it's "not about replacing meat, it's about having more options," which is a sentiment emphasized by a few of our participants who work closely with beef and pork producers. Another shift has occurred in the way consumers perceive new pulse foods, as "hummus was not a novelty ethnic food for my generation, it is

commonly found in stores, so this could happen with other bean products, too."

Finally, participants in this study found it useful to be a part of these interviews, because it is "good to see a trajectory of where we've been and where we're going," as well as needing to "look at the past to see if we're moving in the right direction." Thanks to the valuable information provided by our interviewees, we can continue that mission with research and applicable results.

Discussion

Our assessment of pulse consumption in the north central region, one of the prime production areas in the U.S., showed a variety of responses across professionals working with pulses. The results revealed that in promoting pulses, we have to take into account both production and consumption. Interviewees showed differences in responses as to which drives which: does pulse production drive consumption, or vice versa? Most often the data points to consumer demand driving production. Those participants working in commodity groups, production, and research are all striving to meet this demand in various ways. Commodity groups work with producers and consumers in supporting production through research, and developing marketing strategies for consumption. Researchers are looking at new varieties for better production value as well as getting pulses from field to market by cutting in half the time of seed development to seeding the field.

When participants answered questions on their first memories of pulses, or how they got started eating them, a bit of prompting was necessary. Some said they really did not eat pulses growing up. Perhaps this gap is because in thinking about current pulse use, or what they think would be healthy amounts and types to eat, they may have felt their childhoods were lacking in sufficient supply. However, after slight prompting, many found that they had strong traditions of eating pulses growing up, such as canned pork and beans, canned baked beans, grandma's homemade bean soup or split pea soup, and beans baked in mixed casseroles and added to chili. This would seem to contradict later responses when questioned about who is eating pulses, that is, consumer categories. Many responded that it is the younger demographic who are driving consumption, and perhaps that is true in a "trendy" way, as stated in Table 2, but pulses have been around a long time, and are inexpensive. Pulses were and still are a solid base for traditional cooking that has been passed down through the years, even if only in sweetened and canned form.

New pulse products and pulse promotion go hand in hand. Some of the earlier pulse flour products, such as pastas, did not have a positive consumer response because of the texture. Both participants and literature point to the improvement of the newer iterations of pulse flour products, yet once consumers have tried the initial pastas and other introductory pulse value-added products, and found them unpalatable or even difficult to digest, they may be reticent to try the new and improved pastas and chips. This is where restaurants, especially so-called "high-end" venues as one participant indicated, would be a good place to promote some of these new products, using talented chefs to prepare palatable dishes.

Terminology is definitely an issue across the board for all the participants in our study. As noted, the two terms remain separate in the realms of commodity groups and research institutions, at least in our region. There has been a push for increased pulse use since the International Year of Pulses was declared in 2016, so more of the educational and Extension efforts are geared towards the term 'pulses,' yet participants report that while most consumers understand what 'beans' and 'peas' are, they are totally confused by the term pulses. Participants report that when talking to customers, consumers, or producers, they will use the term pulses but immediately afterward list either the individual pulse they are referring to, or list all in a group of examples in order for the person to understand.

Nutritional value of pulses and MyPlate[34] suggestions from participants work together in promoting dietary health, along with soil health. We used a field to fork continuum in our interview process, and we found that growing pulses sustains soil health, and eating pulses sustains human health. In addition, because pulses are found in two places within MyPlate[34] guidelines, which some found confusing (while some found beneficial), one participant suggested that pulses should have their own category of nutritional value, just like fatty fish has its own suggestion for twice a week consumption. However, an important adjustment for consideration in both the U.S. MyPlate[34] and the European FBDG[5] are where to "count" all of the new pulse-based products like pastas and 'burgers'—if they count as a protein, then how would a two-ounce serving of pasta, for example, count as units of protein, or how would a pulse-based 'burger' count as a vegetable?

Categories of consumers who use pulses, and the types of pulses they use revealed interesting results.

We were expecting more culturally-specific or ethnic populations to be reported, yet only one participant noted Mexican/Hispanic as a consumer group eating a lot of pulse foods. What we did get were more geographical-specific populations, such as European or USDA's Section 32 developing nations customers, and ideologically-aligned groups, such as environmentally-conscious, locally-grown consumers. The income category revealed both higher- and lower-income consumers used pulses, so contradictory information was received here as well. Remember, we left this question open, so the respondents were the ones who ultimately created these categories. This information could be used for market research, but also as a way to develop a target audience for promotion.

A number of obstacles were reported by interviewees. Many answers supported what is usually found in the research, such as lack of knowledge in cooking and planning meals with pulses, or not liking the taste or texture. These barriers were listed in cooking, cultural, and marketing obstacles columns (see Table 3). Research and production barriers are currently being addressed by the research institutions and commodity groups that represent them, but those are much slower processes to overcome than some of the education- and marketing-based obstacles.

One obstacle in particular, listed under cultural, was summarized as the phrase 'commodity culture wars.' Culture war here refers to a mostly unspoken but severely felt sentiment of beef (and sometimes pork) producers in direct competition with pulse producers. The commodity participants in our study were especially emphatic in bringing this up as an issue. To illustrate, when asked about obstacles, one participant stated:

"Beef versus pulse growers and the politics/economics of that whole issue, especially when it's a line talking about plant-based protein on a piece of legislation, some pulse growers are actually beef growers as well and vice versa; don't want producers to be embarrassed saying they grow pulses; don't ever want to disparage other commodities when promoting one commodity; don't want to compare different products because there is nutritional value in eating a wide variety of foods; aggressive marketing tactics are not good—saying you want to get rid of meat-eating by such and such a date, for example." When the wider food marketing system operates with these types of messages for plant-based, it seems inherently against promoting meat-eating. Promotional ideas as well as solutions to stated obstacles were found in the two corresponding question categories as well as peppered throughout the interview transcripts. We analyzed and summarized these in a list of two sub-categories: actions for current promotion, and ideas for future development. Some of the proposed solutions to stated barriers were listed in the former, and more general promotional ideas not tied to a particular problem or obstacle were listed in the latter column (see Table 4). For example, when a participant stated that pulses are not found on restaurant menus, a stated solution was to have conversations with local restaurants and ask them to develop one or two pulse-featured dishes. One of the more innovative solutions to the problem of pulse snacks being so expensive, was to work with a local/regional snack maker in our area that already manufactures potato chips (or crisps), and have them develop a pulse snack chip (crisp) or cracker that would be more inexpensive and readily available in the region.

The interviewees provided ideas for future pulse promotion, such as considering consumers' perceptions of pulses or replicating the success of the hummus marketing story with other types of pulses. Obviously, continued education and outreach through Extension and other venues were suggested, along with developing local "Made in the Midwest" campaigns, for example. We need to bridge our regional commodity culture war gap and continue working with commodity groups and marketing information in a manner that attenuates the more national and international promotion of plant-based *in lieu of* meat. Working with smaller beef and pork farmers is key in bridging the gap, since large-scale meat manufacturing outfits have less risk involved. Finally, working with school lunch programs was considered vital in two ways: addressing the consumer category of younger ages as well as promoting nutritional value for children. When children are habituated to eating pulses as part of their "normal" and everyday food choices, the problem of promotion will be ameliorated in the future.

Conclusion

This study sought to gather local and regional expertise to gain a more intimate view of barriers to and solutions for increased pulse consumption. Our aim was to match previous research and its literature to what we found currently regarding these barriers and solutions. We found a breadth of information across various pulse professionals involved with education to production of pulses.

One limitation of this study were the few numbers of participants we interviewed. However, as we were limited in resources and time, we felt that interviewing at least one pulse professional in the

various sub-specialties in our region enabled us to get a breadth of ideas, as opposed to scaling data points. In order to get a wide swath of the issues in current pulse use, we were able to pinpoint some areas of concern.

Future research should be conducted in the obstacles to pulse use and production mentioned, such as the commodity culture wars. Getting at the heart of what is going on and looking into any previous research available would be valuable in promoting overall better human health through pulse consumption. Bridging the gap would mean education in flexible meal preparation and cooperation among regional and local producers of both meat and pulses, which would further strengthen communities as a whole.

More research may be warranted in use of the term 'pulses,' especially in the context of marketing, to see how either the word 'pulse' could be incorporated into future strategies, or to go in the direction of promoting individual pulses in succession. Research into local marketing strategies specifically for grocery stores could be fruitful and applicable immediately. This study resulted in a variety of suggestions that could be developed into programs and delivered throughout the world.

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