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Economic Analysis of Using Soybean Meal as a Mushroom Growing Substrate

Jason Fewell
Cole Gustafson

Department of Agribusiness and Applied Economics
Agricultural Experiment Station
North Dakota State University
Fargo, North Dakota 58105

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ABSTRACT

Mushrooms have been grown commercially on many different substrates for years, usually agricultural by-products such as straw or stover. Increased popularity for specialty mushrooms with consumers has led to increased production and great demand for economic substrates. Oyster mushrooms are easier to grow relative to other types of mushrooms and their production has increased dramatically in recent years. This study examines the economic feasibility of using soybean hulls as a primary substrate for oyster mushrooms, replacing traditional wheat straw. The study uses a cost-benefit analysis to determine an optimal substrate based on yield and the number of crops harvested per year.

The study shows that soybean hulls, combined with corn gluten or soybean meal increases yield 4.5 times, which more than offsets for higher costs for soybean hulls. The use of soybean substrate also allows a producer to raise about four more crops per year, which in turn uses fixed resources more efficiently and increases profitability.

Keywords: oyster, mushrooms, substrate, soybean, hulls, meal, economic, feasibility

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INTRODUCTION

Mushroom production is a small, but important industry in many regions of the United States. Mushrooms could become an important addition to farmers looking for a value-added product and a way to supplement farm income while making use of byproducts or co-products from other crops. Wood, sawdust, straw, stalks, hulls, or meal will all support mushroom growth. The growth of different types of mushrooms requires different types of substrate, and the availability of different types of material may dictate which type is used. This is especially attractive in North Dakota because of the large number of crops raised.

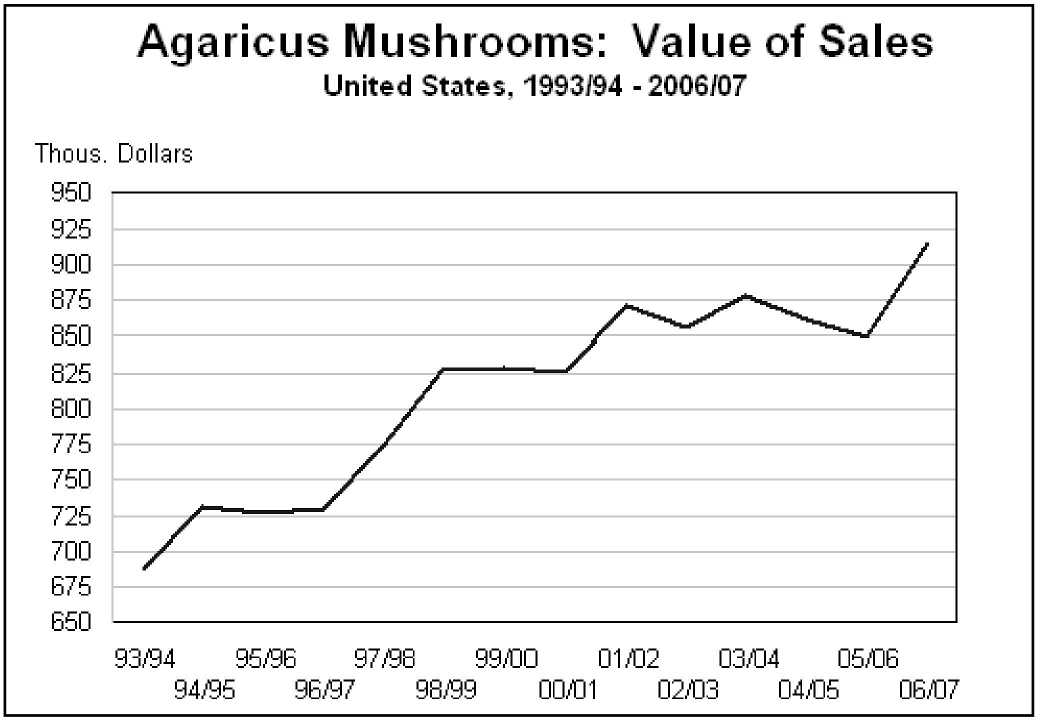
Since mushrooms can be grown on nearly any type of agricultural residue, they are an ideal crop for rural areas with large amounts of cultivated acreage and residue from field crops. Numerous types of mushrooms exist, but the most commonly consumed are the *agaricus*, or “white button” (Burden, 2006). Other specialty mushrooms consumed in the U.S. include oyster, shiitake, Italians, criminis, and maitake (Burden, 2006). In the Pacific Northwest and Northeastern United States, chanterelles, morels and oysters grow in the wild and can be gathered and sold at farmers’ markets or retail stores (Burden, 2006).

Pennsylvania is the largest producing state of domestic Agarics at 61% of U.S. production, and California is second at 14% (USDA, NASS, “Pennsylvania,” 2007). Production for the rest of the United States is broken into three regions: East, Central, and West. The East region includes Connecticut, Delaware, Florida, Maryland, New York, Pennsylvania, Tennessee, and Vermont; the Central region includes Illinois, Oklahoma, Texas, and Wisconsin; and the West region includes California, Colorado, Montana, Oregon, Utah, and Washington (USDA, NASS, “Mushrooms,” 2007). Only data from California and Pennsylvania are broken down by state; the remainder of the region’s production is listed separately (USDA, NASS, “Mushrooms,” 2007).

With consolidation in the mushroom industry, fewer farms are producing mushrooms, even though the value of mushrooms has increased significantly in recent years. Figure 1 shows the value of *Agaricus* mushrooms, but production of specialty mushrooms such as shiitakes and oysters has risen even faster. A likely reason is that larger companies are growing *Agaricus* mushrooms, and smaller farmers are unable to enter the industry, so they turn to production of specialty mushrooms.

Production of *Agaricus* mushrooms is labor intensive and requires more sophisticated technology than a small or beginning producer could acquire (Burden, 2006). In the late 1980s, mushroom farm numbers began to decline as only a few farms began to purchase this new technology and increase productive efficiency while remaining small farms quit raising mushrooms (USDA, RMA, 1995). A few farms dominate mushroom production. In 1994, five to six farms produced five to 20 million pounds each year, 100 farms produced one to five million pounds each year, and six farms produced most of the country's specialty mushroom production (USDA, RMA, 1995).

Figure 1. Value of Sales of Agaricus Mushrooms



Source: USDA, NASS. August 23, 2007. "Mushrooms." Retrieved September 8, 2007. Available at http://usda.mannlib.cornell.edu/usda/nass/Mush/2000s/2007/Mush-08-23-2007_revision.pdf .

Initial research done at North Dakota State University has shown yields for oyster mushrooms are highest when using soybean hulls as the primary substrate rather than wheat straw, sunflower hulls, or sugar beet pulp. While wheat straw or corn stalks may be less expensive and more available, yield increases could offset the additional costs of purchasing the soybean substrate. In addition, this initial research indicates that mushrooms grow more quickly on soybean hulls enabling greater throughput in fixed building facilities. Benefits of using soybean substrate include another outlet for byproducts from soybean processing, and another way to increase farmers' incomes by increasing the quantity of mushrooms available for sale. In addition to helping mushroom farmers increase profitability, soybean producers and processors could benefit with the increased demand for their product.

Animal producers also could benefit from the addition of spent substrate into their herds' diets. Hall, et al., (2007) are studying the fiber and protein content in spent substrate to determine if it will break down into digestible components which could be added to livestock feed as a protein source. This could benefit mushroom producers by giving them a market for the substrate after the production cycle. More research needs to be conducted on the nutritive value of spent mushroom substrate before the economic benefits (if any) can be determined.

The following sections of this report provide an overview of the mushroom industry, typical markets for mushrooms, health benefits of mushrooms, and a cost-benefit analysis of using soybean hull and meal in place of other substrates, particularly wheat straw and corn gluten.

Mushroom Production

Oyster and Shiitake are the most commonly grown specialty mushrooms in the U.S., and are relatively easy to grow without excessive labor or technological requirements (Burden, 2006). Oyster mushrooms grow relatively quickly, which adds to their appeal for small or first time growers (Growing mushrooms, 2003). Small mushroom producers typically raise specialty mushrooms because competition is less fierce than for common white button mushrooms.

Mushroom production begins by obtaining and preparing substrate for pasteurization. Sterilization is essential for mushroom production because other molds or bacteria can infect the substrate and cause significant yield losses or even prevent mushrooms from growing. In the past, wheat straw has been used for the initial substrate, but other agricultural residues can be used, such as soybean hulls. Pennsylvania State University researches determined 75 percent cottonseed hulls, 24 percent wheat straw, and one percent ground limestone makes an excellent substrate because of its water retention qualities, and it eliminates the need to chop as much straw (Cultivation of Oyster Mushrooms, 2003). Usage of soybean hulls, as a replacement for this traditional substrate mixture, would reduce the need for straw and should be a compatible replacement for cottonseed hulls.

Commercially, mushrooms are typically grown indoors to ensure proper humidity and temperature levels. Changes in temperature and humidity at particular growth stages are necessary for production (Growing Mushrooms, 2003). The need for a building is the largest expense for a mushroom producer in the Northern Plains. The building need not be large for a small producer, but depending on expansion plans, more room may be added later.

Spawn which are used to infest the substrate are purchased from spawn makers because of the difficulty and complexities associated with its production (Cultivation of Oyster Mushrooms, 2003). The spawn are infested at a rate of five percent of the wet weight of the substrate, which increases yields (e.g. weight of original substrate), possibly as much as 50 percent, according to research at Pennsylvania State University (Cultivation of Oyster Mushrooms, 2003).

Mushroom yields are measured in percentage terms rather than in pounds, tons, or bushels per acre or square foot. The substrate is weighed at the beginning of the process, and the mushrooms are weighed at harvest. The yield is then determined by dividing the weight of the mushrooms by the beginning weight of the substrate, which gives the percentage of mushrooms per pound of substrate. A yield of 50 percent would mean the mushrooms converted half of the substrate into mushrooms. If a producer spawned 100 pounds of substrate and harvested 50 pounds of mushrooms, the yield would be 50 percent.

Mushroom Demand Increasing Due to Health Considerations

The addition of mushrooms to the diet can have beneficial health effects. Along with protein and carbohydrates, mushrooms contain many nutrients, minerals, and antioxidants. Mushrooms have been consumed for medicinal purposes in Japan and China for centuries (Health Benefits of Mushrooms, 2003-2004). Many drugs and dietary supplements contain at least some component produced from fungi because of their immune system enhancing qualities (Fungus Among Us, 2005).

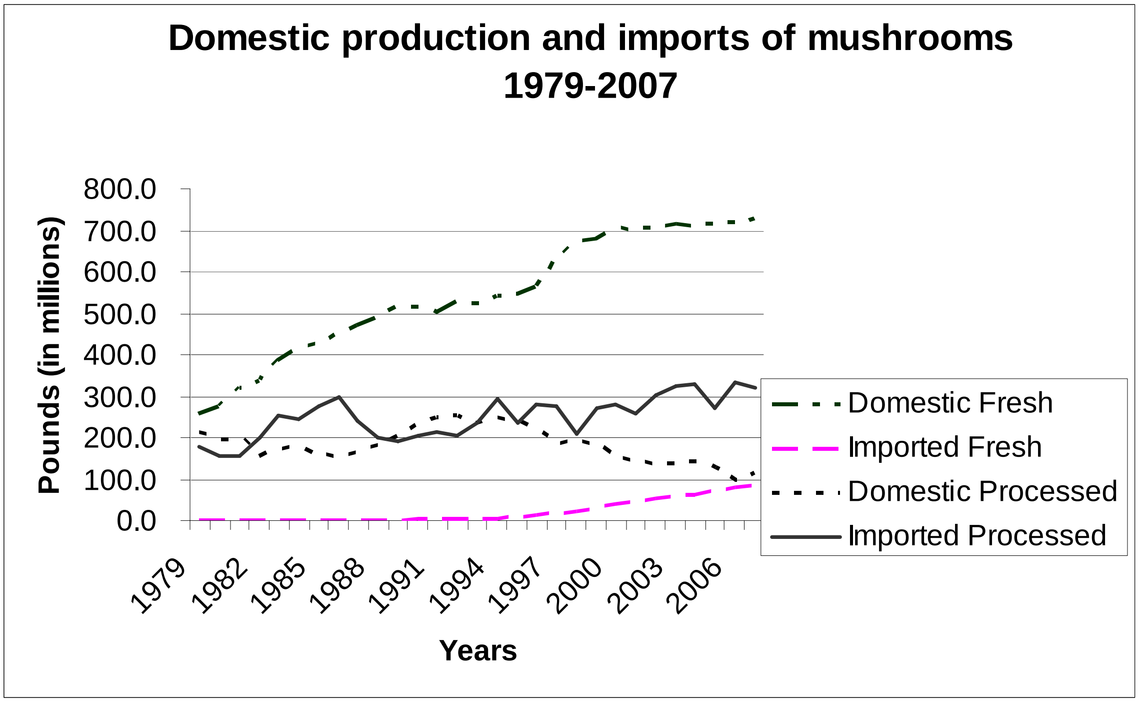
Research conducted by the organization Cancer Research has shown white button mushrooms can lower the risk of breast cancer. Conjugated linoleic acid is found in mushrooms, and the study indicated it can stop cancer cell growth through blocking cancer cell reproduction (Chen, et al., 2006). Further research by the organization may show the mushrooms take up the conjugated linoleic acid through absorption of the substrate (Chen, et al., 2006). This research follows Hall, et al. suggestion that mushrooms can take up nutritious isoflavones from soybeans (Hall, et al. 2007). Isoflavones are most commonly found in soybeans, and have been shown to help ease menopause symptoms, decrease heart disease risk, protect against prostate enlargement, improve bone health, and reduce cancer risk (Isoflavones, 2006).

A study at San Diego State University has indicated mushrooms can aid in weight loss. According to Mark Kern, PhD, RD, people lost more weight when on a diet high in mushrooms and other vegetables as opposed to other low carbohydrate/high protein and low fat diets (Kern, 2007). Participants in his study also observed decreased levels of low density lipids without a reduction in high density lipids, unlike those only on the low fat diet (Kern, 2007). The participants also noted lowered blood pressure levels and were less likely to become hungry after consuming the high vegetable diet rather than the low fat diet (Kern, 2007).

Domestic Mushroom Production and Prices

As people have become more health conscious, mushroom production has expanded, particularly the market for fresh mushrooms. The U.S. mushroom industry as a whole has grown substantially in recent years (Appendix Table 1). Figure 2 shows that the total quantity of mushrooms available to U.S. consumers (the total of domestic production plus imports of mushrooms) for both fresh and processed markets has risen from 649.8 million pounds in 1979 to 1,246 million pounds in 2007. However, there are two segments of the mushroom industry – processed and fresh markets. Trends in each market segment have diverged. While domestic production of mushrooms grown for processing has fallen slightly, domestic fresh production has rapidly increased. Likewise, the quantity of imported mushrooms for processing has climbed only slightly. This is in contrast to the fresh market where the quantity of imported fresh market mushrooms has risen significantly from nil prior to 1990.

Figure 2. Domestic Production and Imports of Mushrooms, 1979 to 2007

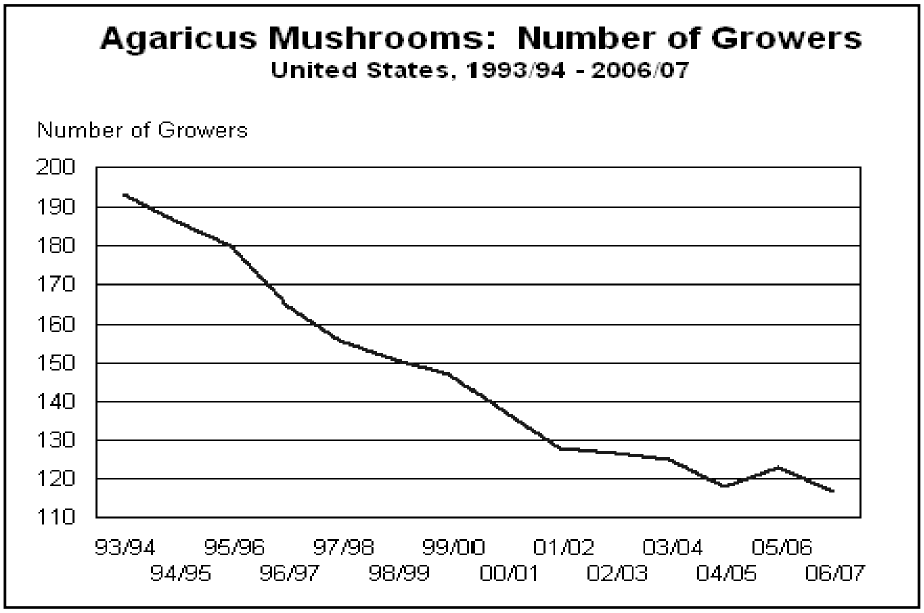


Source: USDA, Economic Research Service yearbook tables.
http://usda.mannlib.cornell.edu/usda/ers/89011/Table153.xls.
http://usda.mannlib.cornell.edu/usda/ers/89011/Table154.xls.

[1]Crop year runs from July 1 of the year listed to June 30 of the following year.

[2]2006 and 2007 are ERS estimates as of June 19, 2007.

Figure 3. Number of U. S. Growers of Agaricus Mushrooms



Source: USDA, National Agricultural Statistics Service.
http://usda.mannlib.cornell.edu/usda/nass/Mush//2000s/2007/Mush-08-23-2007_revision.pdf

As with other areas of agricultural production, the number of mushroom producers has declined (USDA, NASS, 2004). The total number of mushroom producers in the U.S. is 279 (USDA, NASS, 2007). The number of growers producing specialty mushrooms has increased in recent years from 170 in 2003/04 to 193 in 2004/05, 205 in 2005/06, but then fell back to 179 in 2006/07, 60 of which produced oyster mushrooms (USDA, NASS, 2007). To be counted by USDA, a grower must have 200 natural wood logs producing specialty mushrooms, and those producing both Agarics and specialty mushrooms are included (USDA, NASS, 2007).

Production of organic mushrooms totaled 36.2 million pounds for the 2006/07 growing year, with 22 percent of organic mushrooms being non-Agarics (USDA, NASS, 2007). Organic producers of mushrooms account for 14 percent of all mushroom growers, or 38 producers (USDA, NASS, 2007).

Production of specialty mushrooms has increased at a faster rate than that of other mushrooms. Oyster mushroom production has increased 338% from 1986 to 2006. The value of production has also increased, while prices have remained relatively stable for the 20-year period.

Figure 4. Production of Oyster Mushrooms, 1986 to 2006

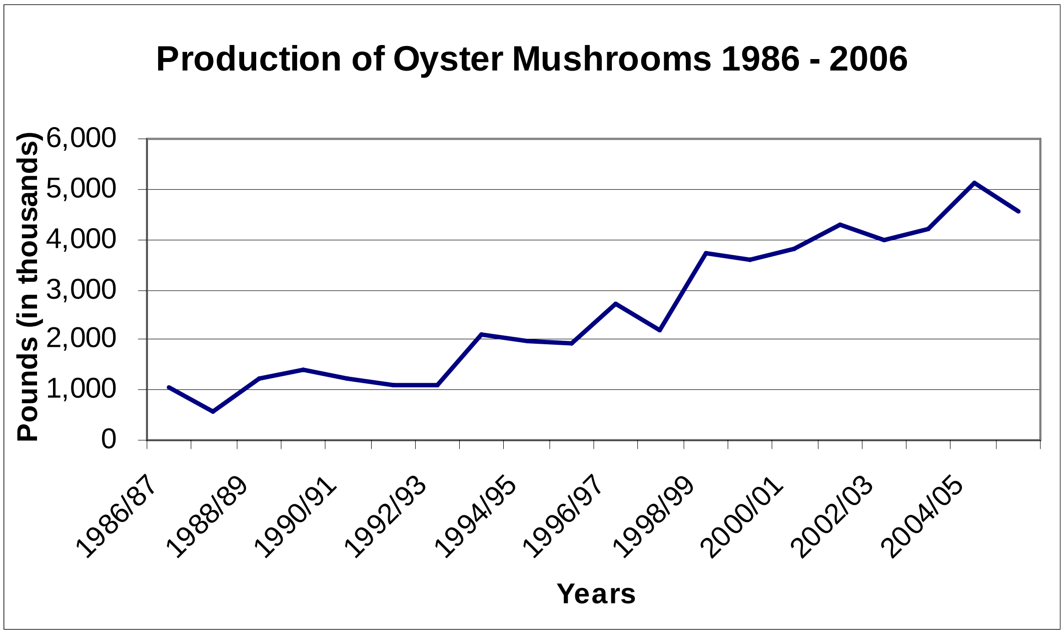
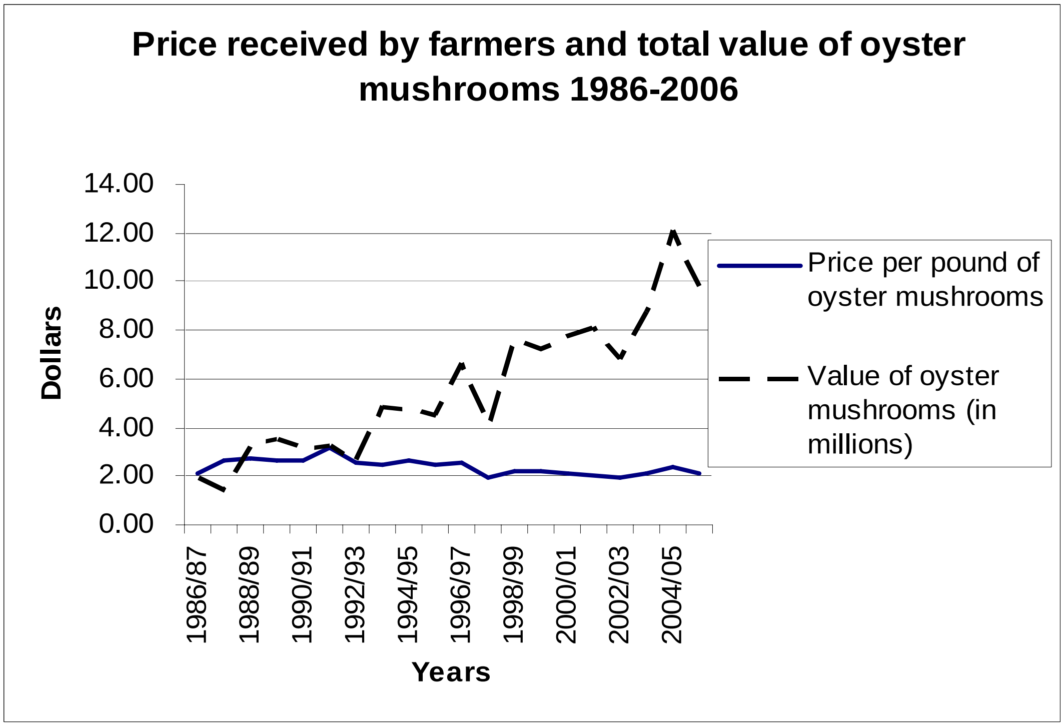


Figure 5. Price Received by Farmers and Value of Oyster Mushrooms



Source: USDA, Economic Research Service yearbook tables.
http://usda.mannlib.cornell.edu/usda/ers/89011/Table152.xls
[1]Crop year runs from July 1 of the year listed to June 30 of the following year.
[2]Source: USDA, National Agricultural Statistics Service.
http://www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/Crops/mushrm.pdf

Mushroom Market Segment

Established producers typically market specialty mushrooms to retail outlets, and the market is quite competitive. New producers of Agarics mushrooms have difficulty competing on a wholesale level with large companies in Pennsylvania or California (Beetz and Kustudia, 2004). In 1994, Campbell's Soup Company owned eight mushroom farms in the U.S., and Monterey Farms operated five in California, Texas, and Tennessee (USDA, RMA, 1995). As noted above, specialty mushrooms also are easier to grow than Agarics, making profitability more likely, providing a market can be established. Therefore, developing a niche market is the best alternative for small mushroom producers. Selling directly to local supermarkets, farmers' markets, or other retail outlets poses the best opportunity for profitability. Becoming part of a cooperative or other mushroom producing organization could help give a producer a necessary outlet for his/her commodity (Burden, 2006). Marketing commodities on the internet is a way for many producers to sell their crop (Burden, 2006)

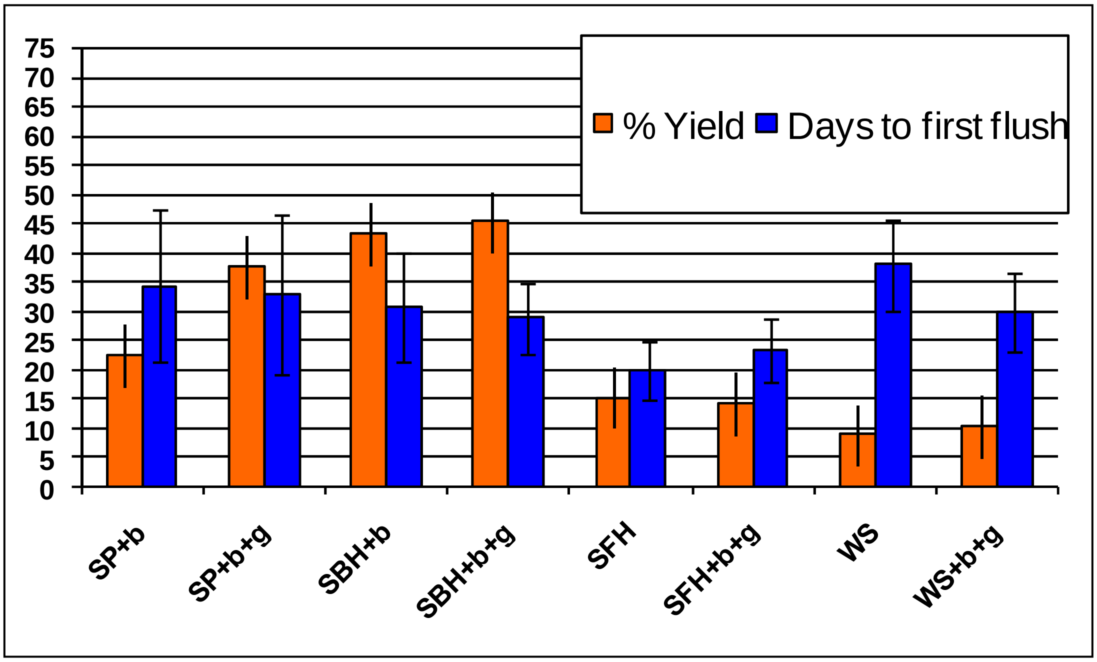
Oyster mushrooms can be marketed locally because they have a relatively short shelf life and are difficult to ship due to their fragility (Beetz and Kustudia, 2004). Marketing to a local buyer enables growers to benefit from reduced transportation costs and provides a steady market. Providing a steady supply is important for growers intending to market their product locally (Burden, 2006).

Mushroom production in North Dakota and the Upper Midwest is extremely small. Data were not available for the number of farms or tons of mushrooms produced in either Minnesota, North Dakota, or South Dakota. For North Dakotans interested in raising mushrooms, marketing under the "Pride of Dakota" label could be beneficial and provide a market advantage or point of entry. Only one company currently advertises mushrooms as a choice of products on its website, http://www.prideofdakota.nd.gov/MemberCompanies/MemberListing.asp. If a market could be established for locally grown mushrooms, a mushroom farm may be a viable economic enterprise in the state. Mushrooms grown under the Pride of Dakota label make an excellent choice for people across the country who desire fresher, more natural food.

Market Potential for Soybean Hulls and Meal as Substrate

In previous research at NDSU, corn gluten was added as a supplement to substrate to produce oyster mushrooms (Hall, et al., 2007). However, corn gluten is mostly protein. Soybean meal (also high in protein) could be an excellent replacement for corn gluten (Hall, et al., 2007). Protein rich substrates help supply nitrogen, which increases mushroom yields (Hall, et al., 2007). According to Hall, et al., yield of oyster mushrooms grown on soybean hulls was 45 percent, indicating 2.2 pounds of substrate is needed for one pound of mushrooms (Hall, et al., 2007). Figure 6 shows the yield of oyster mushrooms grown on various types of substrate.

Figure 6. Average Percentage Yields of First Flushes and Day from Inoculation to First Flush of Oyster Mushrooms Harvested on Various Substrates.



Source: Hall, Clifford III, Charlene Wolf-Hall, Greg Lardy. 2007. "Soybean Substrates in Mushroom Production and Animal Feed Supplements." North Dakota State University.

SBH = Soybean hull
SFH = Sunflower hulls
SP = Sugar beet pulp
WS = Wheat straw
b = buffer added, 5% calcium carbonate and 5% calcium sulfate
g = corn gluten added, 20%
Error bars represent standard deviations
Percentage yield determined by (weight fresh mushrooms/weight substrate) * 100

If five percent of the nation's mushrooms were grown on soybean substrate, then based on Hall's findings, the 845 million pounds of mushrooms grown in 2006/07 would require 92.95 million pounds of soybeans. If ten percent of the nation's mushrooms were grown on soybean substrate, 185.9 million pounds of soybeans are required. This amounts to 3.1 million bushels of soybeans, or production from 72,600 acres based on United States 2006 average yields of 42.7 bushels per acre (USDA, NASS, 2007). In North Dakota, where soybean yields are less than the national average, 100,000 acres' production could be used to supply these soybeans.

With regard to oyster mushrooms, the 4,748,000 pounds produced in 2006/07 would require 1.04 million pounds of soybeans, or 17,409 bushels—production from 408 acres at the 42.7 bushels per acre and 562 acres at 31 bushels per acre. The value of the soybeans is approximately $9.00 per bushel (CBOT), making the commodity valuable compared to historic prices. The high soybean prices translate to higher soybean meal prices as well. Soybean meal prices are currently approximately $235 per ton (USDA, AMS).

Economic Analysis of Using a Soybean Hull/Meal Substrate

Crushing a 60-pound bushel of soybeans typically yields 44 pounds of 48% protein meal, four pounds of soybean hulls, one pound of waste, and 11 pounds of soybean oil (CBOT Soybean Crush, 2006). If hulls are not separated from the meal, a bushel of soybeans yields 48 pounds of 44% protein meal, one pound of waste, and 11 pounds of oil (CBOT Soybean Crush, 2006).

While soybean meal prices are readily available on multiple websites and the commodity is traded on the Chicago Board of Trade, prices for soybean hulls independent of the meal are difficult to find. Data available from USDA's Economic Research Service shows historic prices for 48% soybean meal, but not 44% meal, which would be advantageous because the price for soybean meal and hulls could be separated more easily. In this analysis, the prices for both meal and hulls come from USDA's Agricultural Marketing Service website, which publishes weekly, daily, or monthly prices for commodities in specific regions of the country. The price of soybean hulls is that quoted for the Kansas City weekly review of feedstuffs prices from processors located in Kansas City and St. Joseph, MO. Bulk soybean hulls are listed between $95 and $115 per ton, and soybean meal is listed between $233 and $242 per ton (USDA, Kansas City Weekly Feedstuff Review).

Data for straw and corn gluten prices also come from the AMS website, and are also regional auction or local prices. The price for straw in Northeastern Kansas hay and straw auctions on September 7, 2007 was $50 to $70 per ton (USDA, Kansas Hay Market Report). The price for corn gluten feed in Kansas City is $125 to $130 per ton (USDA, Kansas City Weekly Feedstuff Review).

USDA's yearly average prices received by farmers for oyster mushrooms of $2.41 per pound and the above prices paid for soybean hulls, meal, straw, and corn gluten feed are used to calculate the cost-benefits of using each product as mushroom growing substrate. A 45% yield (45% of the original weight of substrate) is assumed for the mushrooms grown on the soybean hull/meal and soybean hull/corn gluten substrates, and a 10% yield is assumed on wheat straw, as noted in Figure 1 above. Prices for inputs used in the analysis are all at the low end of the quoted prices. The following formula is used to calculate revenue, holding all other expenses constant.

$$R = (P_m * \%S) - (P_s * S)$$

where: R = revenue

P_m = price of mushrooms

S = pounds of substrate

$\%S$ = percentage yield on S pounds of substrate

P_s = price of substrate material

To analyze revenue with 100 pounds of wheat straw as substrate,

$$R = (P_m * 0.10S) - (P_s * S)$$
$$R = (2.41*(0.10*100)) - (0.025*100)$$
$$21.60 = 24.10 - 2.50$$

For benefit-cost analysis with soybean hulls and corn gluten and then soybean hulls and soybean meal, the formula is adjusted slightly to reflect the percentage of each product as a share of substrate.

$$R = (P_m*0.45S) - (P_{SH}*0.80S + P_{CG}*0.20S), \text{ and}$$

$$R = (P_m*0.45S) - (P_{SH}*0.95S + P_{SM}*0.05S),$$

where: R = revenue
P_m = price of mushrooms
S = pounds of substrate
P_{CG} = price of corn gluten at 20% of substrate (as observed in Figure 1)
P_{SH} = price of soybean hulls
P_{SM} = price of soybean meal at 5% of substrate
.45S = 45% yield on S pounds of substrate

First, consider an analysis using 20% corn gluten feed and 80% soybean hulls:

$$R = (2.41*0.45*100) - (0.0475*0.80*100 + 0.0625*0.20*100)$$
$$103.40 = 108.45 - (3.80 + 1.25)$$

Next, consider using 95% soybean hulls and 5% soybean meal:

$$R = (2.41*0.45*100) - (0.0475*0.95*100 + 0.1165*0.05*100)$$
$$103.36 = 108.45 - (4.51 + 0.58)$$

The analysis shows a slightly better outcome when using soybean hulls and corn gluten rather than soybean hulls and soybean meal, but definitive data on yields from soybean meal substrate is still unknown.

Usage of soybean hull substrate poses another advantage in that the days to first flush are shorter than with other substrates, especially wheat straw. As noted in Figure 1, days to first flush using wheat straw substrate are approximately 38 days. Days to first flush with the soybean hulls plus buffer substrate are about 30 days, and when corn gluten is added, it becomes about 28 days. The ten-day advantage of soybean hull substrate over wheat straw is that growers can make better use of their facilities.

Using wheat straw substrate, an oyster mushroom producer can expect 9.13 (365/40) turns per year. When soybean plus buffer substrate is used, the number of turns per year increases to 12.17 (365/30). When corn gluten is added to the substrate, the turns per year increase 1.4 times to 13.04 (365/28). If replacing the corn gluten with soybean meal does not change the days to first flush, the number of turns per year would remain higher with soybean substrate than with wheat straw. Using the 100-pound substrate example above, the yearly return using wheat straw would be approximately $197.21 (21.60*9.13), holding other things constant. Using the soybean hull/corn gluten substrate, yearly returns would be approximately $1,348.34 (103.40*13.04), other things constant. The soybean hull/soybean meal substrate would yield an annual return of approximately $1,347.81 (103.36*13.04), holding all else equal.

High transportation costs make the use of soybean hulls and meal an issue to consider, since mushroom growers would need to transport the substrate to their farm. Transportation of straw, however is also quite expensive. According to research studying the feasibility of using biomass for ethanol production, freight rates for hauling straw to an ethanol plant are approximately $3.72 per loaded mile (Leistritz, et al., 2006). Current rates for trucking feed and grain are approximately $3.30 per loaded mile in the North Central region of the United States (USDA, AMS, Quarterly Update). On a per ton basis, transportation of straw is more expensive than other products because its bulky nature does not allow a trucker to reach his/her maximum allowable weight. The straw must be chopped into pieces one to three inches long for best results, although a farmer with a hay grinder could accomplish this, hopefully for a low cost (Growing Mushrooms, 2003). Soybean hulls and meal are already processed at the crushing plant, so no more chopping, shredding, or mixing is required. Eliminating an operation would be in the best interest of the mushroom grower because he/she could keep expenses lower and would not be subject to delays caused by an inadequate supply of processed substrate.

Depending on the size of mushroom producer, buying hulls and meal by the truckload is the best option because the amount of material needing storage is significantly less. Storing the material may be an issue if the producer does not have adequate storage space, but installation of a steel bin could alleviate this concern. With straw, storage is more of a concern because a larger building would be needed to keep the material dry and free of rodents.

Conclusion

Mushroom production, while not one of the most important crops in the United States, has been increasing in recent years. The most popular type of mushroom is the common “white button” mushroom. Production of all mushrooms increased 92 percent from 1979 to 2006, with production of specialty mushrooms increasing even faster. One reason for this is likely because economies of size prevent smaller producers from producing *Agaricus* mushrooms, which require large technological and labor inputs.

Mushrooms offer many health benefits and have been used in medicines for centuries. The use of soybean substrate may augment these benefits because the mushrooms may take up nutritious isoflavones from the soybeans.

Oyster mushrooms, a specialty mushroom, can be grown on any kind of lingocellulosic material. In the past, the primary substrate has been straw, but research has shown other materials such as cottonseed or soybean hulls increases yields significantly. At North Dakota State University, research is ongoing to determine the optimal soybean hull/soybean meal mixture to maximize yields. The addition of corn gluten to soybean hull substrate has improved yields and shortened the days to first flush, both of which contribute to a mushroom growers' profitability.

In addition to benefiting mushroom growers, soybean substrate has a positive impact on the soybean industry by offering another outlet for soybean meal. With the increased use of soybeans for biodiesel production, soybean-processing plants will require more outlets for meal leftover after the oil has been extracted. Soybean meal substrate has the potential to require the use of 3.1 million bushels of soybeans if only ten percent of the nation's mushrooms adopt the substrate.

The loss of soybean meal for the cattle industry due to the use of soybean substrate may not be felt significantly because the substrate could still be used as cattle feed. The nutritional value and digestibility of the spent substrate is being tested at NDSU, but an economic value is yet unknown.

Analysis shows the economic benefit of soybean hull over wheat straw substrate to be significant. At a level of 80 percent soybean hull to 20 percent corn gluten, yields are increased approximately 4.5 times over that experienced with wheat straw. The increase in revenue for mushroom producers will help them increase their bottom line and remain profitable. Using 95 percent soybean hull and five percent soybean meal substrate did reduce revenue very slightly, only about four cents in the analysis. A grower should figure transportation costs into his/her choice of supplement to the soybean hull substrate and use whichever is less costly based on proximity to a soybean or corn processing plant.

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APPENDIX

Table 1. U.S. Production of Mushrooms, 1979 -2007
(in million pounds)

Crop year[1]	Production		Imports		Total
	Fresh	Processed	Fresh	Processed	
1979	255.8	214.2	0.5	179.3	649.8
1980	275.1	194.5	0.7	155.7	626.0
1981	319.1	198.0	0.8	157.2	675.1
1982	337.2	153.6	1.1	199.5	691.4
1983	388.1	173.5	0.8	252.2	814.6
1984	419.9	175.8	1.0	243.3	840.0
1985	427.2	160.8	1.0	273.9	862.9
1986	454.8	157.1	1.4	297.9	911.2
1987	471.1	162.9	1.2	239.0	874.2
1988	488.2	183.1	1.9	198.7	871.9
1989	516.0	203.1	2.1	190.0	911.2
1990	516.1	237.2	3.5	205.2	962.0
1991	501.2	249.9	4.6	213.8	969.5
1992	527.0	254.0	3.8	203.5	988.3
1993	525.3	234.0	3.3	233.8	996.4
1994	541.0	250.1	5.0	293.1	1,089.2
1995	546.0	240.7	7.0	234.2	1,027.9
1996	564.5	222.9	11.3	279.8	1,078.5
1997	631.1	187.1	18.8	276.2	1,113.2
1998	671.5	189.9	23.2	210.7	1,095.3
1999	682.1	185.9	29.8	271.4	1,169.2
2000	707.2	153.6	38.2	280.1	1,179.1
2001	704.2	141.1	44.6	256.9	1,146.8
2002	709.2	139.2	54.0	303.9	1,206.3
2003	716.8	137.7	59.9	325.5	1,239.9
2004	712.3	141.8	62.4	326.8	1,243.3
2005	714.3	129.1	72.1	269.1	1,184.6
2006[2]	720.0	97.0	79.7	335.0	1,231.7
2007[2]	730.0	115.0	83.0	318.0	1,246.0

Source: USDA, Economic Research Service yearbook tables.
http://usda.mannlib.cornell.edu/usda/ers/89011/Table153.xls.
http://usda.mannlib.cornell.edu/usda/ers/89011/Table154.xls.
[1]Crop year runs from July 1 of the year listed to June 30 of the following year.
[2]2006 and 2007 are ERS estimates as of June 19, 2007.

Table 2. Production, price, and value of oyster mushrooms, 1986 - 2006

Crop Year[1]	Production	Price	Value
	1,000 pounds	$/lb	$1,000
1986/87	1,041	2.15	1,926
1987/88	574	2.62	1,424
1988/89	1,242	2.76	3,221
1989/90	1,402	2.66	3,494
1990/91	1,242	2.67	3,207
1991/92	1,098	3.14	3,287
1992/93	1,089	2.58	2,579
1993/94	2,089	2.50	4,856
1994/95	1,980	2.65	4,773
1995/96	1,941	2.49	4,467
1996/97	2,695	2.59	6,595
1997/98	2,210	1.94	4,014
1998/99	3,729	2.16	7,675
1999/00	3,573	2.16	7,218
2000/01	3,817	2.13	7,745
2001/02	4,273	2.01	8,092
2002/03	3,997	1.91	6,820
2003/04	4,185	2.08	8,714
2004/05	5,125	2.35	12,035
2005/06	4,563	2.15	9,809
2006/07[2]	4,748	2.41	11,424

Source: USDA, Economic Research Service yearbook tables.
http://usda.mannlib.cornell.edu/usda/ers/89011/Table152.xls

[1]Crop year runs from July 1 of the year listed to June 30 of the following year.

[2]Source: USDA, National Agricultural Statistics Service.
http://www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/Crops/mushrm.pdf