MSU Pork Quarterly

Vol. 8, No. 1 *"Information for an industry on the move!"* 2003

"Using Mass Balance to Calculate Manure Phosphorous Production"

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Critical to both the Manure Management Systems Plan (MMSP) and the Comprehensive Nutrient Management Plan (CNMP) is accurate estimate of the manure nutrients produced annually. Michigan is a phosphorous-based state, where the manure phosphorous produced must be utilized on the farm for crop production, or accounted for as moved off the farm for an alternate use. Therefore, the estimate of manure phosphorous produced will determine the land base required for manure applications in a MMSP or a CNMP.

A plan writer will estimate manure P_2O_5 production using three calculation methods. The first method is using Midwest Plan Service (MWPS) 2002 "Manure Characteristics" tables, or "Book Values". The second method consists of multiplying manure tests by estimates of manure produced or "Manure Test Values". The third method is calculating a "Mass Balance" for phosphorous on the farm.

Calculating manure nutrient production based on book values doesn't require any on-farm data. The plan writer will simply refer to the appropriate table as published in MWPS "Manure Characteristics" to determine the manure nutrient production per day for each phase of production, then multiply that figure by the number of days per year the animals are on the farm. In Table 1, a 150 pound hog (average weight of a pig during the grow-finish phase) will produce 0.08# N, 0.05# P_2O_5, and 0.04# K_2O per day. Multiplying the daily production by the 320 days that the barn is at 100 percent capacity equals the figures given in Table 1 under "Book Values".

Conversely, calculating manure nutrient production based on manure tests and production will require extensive on farm records. First, an accurate manure sample must have been collected from each manure storage facility on the farm. Each sample must have been collected from manure that is well agitated, plus at various intervals as the storage was emptied. Second, manure application records must accurately indicate the amount of manure removed annually. Simply saying, "we empty that pit three times per year and it holds about 250,000 gallons" is not adequate. Either, the manure spreader must have been weighed, the net weight converted to gallons and a the number of loads removed from each manure storage recorded; or the depth of manure in each storage is measured before manure is removed and again when manure removal is complete, then the volume removed is converted to gallons.

In Table 1, the manure test multiplied by manure production would not have been acceptable. The manure tests were collected using the correct method, but the volume of manure produced was determined using book values, adding in estimates of water wasted by the pigs and used while cleaning the barn between sets of pigs. A plan writer would use this information in the MMSP or CNMP, but would need additional documentation to support the conclusion that manure tests multiplied by manure

(Continued on page 2)

What's Inside ...

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production, accurately estimates the manure nutrients produced by the farm.

Supporting documentation to confirm the manure test results may be determined by calculating a "Mass Balance" for phosphorous fed to livestock on the farm. A mass balance for phosphorous is simply a calculation of the amount of phosphorous fed to the pigs on the farm annually, minus the amount of phosphorous removed through the annual hog sales, equaling the amount of phosphorous excreted into the manure. In Table 1, the mass balance for the 1,000 head barn was calculated by multiplying the amount of each diet consumed, by the phosphorous content of that ration. Next the pounds of gain was determined and multiplied by the amount of phosphorous removed by each pound of gain. Finally the amount of phosphorous removed in gain is subtracted from the amount of phosphorous consumed by the pigs through the feed, equaling the amount of phosphorous excreted into the manure. A phosphorous mass balance for 1,000 head, all in-all out, barn is relative easy to calculate because feed utilization and sale weights are normally recorded for these barns. Farrow to finish farms with good records of annual feed purchases, corn fed and hog sales may use those records to calculate the phosphorous mass balance for the farm.

Table 1 represents the differences in estimated manure phosphorous production based on the calculation method. Notice the land base requirement for each method of calculation. Accurate records of manure phosphorous production will result in appropriate land base requirements for manure applications. This table was developed using field data from many farms, and is intended to represent the importance of accurately estimating manure nutrient production. The manure nutrient production and land base requirements on individual farms will be different then what is reported in this table.

Table 1. Manure Nutrient Production using Three Calculation Methods

Calculation Method	Manure N Production	Manure P_2O_5 Production[1]	Manure K_2O Production	Land Base Requirement[2]
Book Values	25,600#	16,000#	12,800#	331 acres
(Manure Test)x(Estimated Production)[3]	22,772#	11,403#	14,216#	236 acres
Mass Balance for Phosphorous		10,243#		212 acres

1. Differences in estimated P_2O_5 may also be due to the inclusion of Phytase® in some diets.
2. Based on soy-corn rotation, 150 bu/ac corn yield and 50 bu/ac soybean yield
3. Based on 457,000 gallons manure produced and manure test results of 49.8# N, 24. 9# P_2O_5 and 31.1# K_2O per 1,000 gallons.

Calculating manure P_2O_5 production using "Book Values" may require the least input from the farm management team, but as Table 1 illustrates, "Book Values" tend to over estimate manure P_2O_5 production. Accepting "Book Values" as the calculation method for the plan may result in over estimation of P_2O_5 production, and an inflated land base requirement.

Manure test and estimated production may more accurately reflect the manure P_2O_5 produced by the livestock enterprise, but the estimated P_2O_5 production must be based on a good manure sample and accurate removal records. Estimated manure production records "kept in our head" are not acceptable for calculating MMSP or CNMP land base requirements.

Most farms already maintain the feed and hogs sales records needed to accurately calculate a phosphorous "Mass Balance" and manure P_2O_5 production. Accurate estimate of manure P_2O_5 will correctly indicate the MMSP or CNMP land base requirements and may avoid needlessly securing manure easements from neighboring farms. Preparation for the MMSP or CNMP process should include gathering feed and hogs sales records that will assist the plan writer with "Mass Balance" calculation. These records will aid in calculating the estimate of manure P_2O_5 production, and result in an accurate estimate of land base requirements.

"Are You Ready For A CNMP? How To Get Started.

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With the new CAFO permit program now in place, many producers are asking themselves where do I fit in this picture? Do I need a CNMP (comprehensive nutrient management plan)? Where do I start? However, whether you are a CAFO or not, Michigan swine producers should be asking themselves the following three questions.

· Is my operation at risk of having a discharge into state surface waters?
· Do I have the land base required for the amount of nutrients that my operation produces?
· Am I keeping adequate records to demonstrate the nutrient management activities occurring on my farm?

Understanding, analyzing, and even possibly correcting any problems relating to these questions is extremely critical to swine producers today. Oftentimes figuring out the answers to these questions must be performed and attended to, before a producer can begin working on a CNMP.

First of all, identifying the potential for a discharge into any nearby surface waters should be addressed. A discharge is defined as the release of nutrients, pathogens, manure, or polluted storm water into surface waters of the state (drains, ditches, streams, lakes, rivers, ponds, wetlands, etc.). In order to accurately make this assessment, consider where runoff from the farm may go when it rains and if/or what nutrients this runoff may be carrying with it. For example, is there ANY runoff (contaminated with manure or feed) leaving an outdoor lot that I may have? If so, where is this runoff going? Is it coming into contact with any of the above mentioned sources of surface water? Could there be the possibility of a breach or leak in any of my manure storage structures? Am I maintaining enough freeboard within my pit? When I handle manure (pumping or applying) is there any chance for a spill, leak, etc.? Do I have an emergency management plan if a leak, spill should occur? Other potential sources of contaminated runoff include composting areas (manure and/or mortality), drains from boot washes and cleaning areas, etc. These are just some of the questions that you as a swine producer may want to ask yourself.

Secondly, do I have the land base required for manure application to remain sustainable. Applying manure at agronomic rates and avoiding nutrient buildup, specifically phosphorus, in the soil is key to a sound nutrient management plan. Therefore, phosphorus is usually the limiting element when determining one's land base requirement for manure application. Specifically in Michigan, those soils testing over 300 lbs/acre Bray P1 should not have any manure applied to them according to the Right to Farm GAAMPs. Furthermore, those soils testing between 150 and 299 lbs/acre Bray P1 should only receive crop removal rates of phosphorus. In order to accurately determine what your required land base would be, it is suggested to determine the total quantity of nutrients (N, P, and K) being produced from your operation and them utilizing your field soil tests and cropping plan to determine if you are in nutrient balance. In other words, does the quantity of nutrients being produced outweigh what your crops can utilize. If your operation is generating more nutrients than what your crops can utilize, you may want to look into a) acquiring more land (hauling farther or to a neighbor's field), b) adjusting feed rations to decrease P_2O_5 (adding phytase), or c) decreasing animal numbers.

Finally, keeping accurate records of soil analysis, manure analysis, and manure application is extremely critical to a successful nutrient management plan and the development of a CNMP. Being able to fully document your manure application activities is not only vital to dealing with any complaints that may arise, but to further understanding the value of the nutrients that your livestock are producing and the contribution that those nutrients can have to your crop production.

In conclusion, a producer's ability to identify and correct potential discharges into surface waters; determine and maintain an acceptable land base for manure application; and develop complete and sound records are three keys towards successful nutrient management, CNMP development, and ultimately environmental assurance for your operation. For more information relating to nutrient management and CNMP development visit the MAEAP web site at http://wwwMAEAP.org or the MSU Extension Manure AoE Team website at http://www.msue.msu.edu/aoe/manure.

Reference: Bolinger, D., N. Rector, and J. Wilford. Manure Management Management: Getting Started. November 2002.

"Strategies to Eliminate Atypical Aromas and Flavors in Sow Loins

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SUMMARY

The presence of atypical aromas and flavors in sow loins may hinder their use as a raw material for value added enhanced whole muscle products. The objective of this study was to determine consumer acceptance of sow loins exhibiting atypical aromas and flavors ("sow taint," ST) marinated with a solution of salt, sodium tripolyphosphate (STP) and sodium bicarbonate (BICARB). Thirty-four ST and twelve commodity loin sections were marinated with four treatment combinations: (15% injection level (PUMP), 0.5% STP, 0.70 molar concentration (*M*) BICARB); 15% PUMP, 0.25% STP, 0.70*M* BICARB; 15% PUMP; 0.25% STP, 0.35*M* BICARB; and 15% PUMP, 0.25% STP, 0.35*M* BICARB). Consumer sensory panel ratings determined that chops from ST loins injected with a 15% PUMP of STP (0.50%) and BICARB (0.35*M*) were not different (P>0.05) than loin chops from marinated (0.25% STP, 15% PUMP) commodity control loin sections for flavor, texture, juiciness, and overall acceptability. These results indicate that a solution containing STP and BICARB minimized the detection of atypical aromas and flavors in sow loins.

INTRODUCTION

Industry feedback indicates the presence of undesirable atypical aromas and flavors ("sow taint," ST) at varying levels in sow carcasses. This ST along with other quality problems such as decreased tenderness, darker lean surface colors, and varying muscle sizes hinders the usage of sow meat for whole muscle products.

Muscles from the carcasses of older meat animals tend to be tougher and darker in lean color, resulting in a less appealing product. The loin eyes of from sow carcasses may be larger in size, but tend to vary due to large body weight fluctuations as a result of intensive gestation, farrowing, lactating, and fattening cycles. Current processing technologies are available to address these quality variations. However, the presence of undesirable aromas and flavors is a greater challenge to address. Previous research (Sindelar, 2002) utilized a trained sensory panel identified concentrations of sodium bicarbonate (BICARB), levels of sodium tripolyphosphate (STP), and injection level (PUMP) that improved sensory responses and reduced levels of ST. To better understand the consumer acceptance of sow loins treated with STP and BICARB, consumer sensory testing was performed. The primary objective was to determine the consumer acceptability of marinated ST loins compared to marinated commodity pork loins.

MATERIALS AND METHODS

Four treatment marinades (TRT1: 0.70*M* BICARB, 0.50% STP, 15% PUMP; TRT2: 0.70*M* BICARB, 0.25% STP, 15% PUMP; TRT3: 0.35*M* BICARB, 0.50% STP, 15% PUMP; TRT4: 0.30*M* BICARB, 0.25% STP, 15% PUMP) were used in this study. The study was designed as a randomized complete block design using a mixed-effects model.

Sow loins possessing undesirable aromas and flavors ("sow taint," ST, N=34) and non tainted commodity pork loins (CNT, N=6) were obtained from a southeast U.S. commercial slaughter plant over an 8 hour shift and were shipped to the Michigan State University Meat Laboratory.

ST loins (N=17) were randomly selected from the total number (N=34) of procured ST loins to determine lipid oxidation. Twenty-four hour and 7 day purge, and 48 hour drip loss analyses were conducted on all ST loins (N=34). The pH, objective and subjective color, marbling, firmness, and proximate composition were determined for all ST (N=34) and CNT (N=6) loins.

ST loin sections (n=68) and CNT loin sections (n=12) were fabricated from ST and CNT loins (N= 34, N=6, respectively) into anterior and posterior sections. Treatment marinades were randomly assigned to ST loin sections. The CNT loin sections were injected with a control marinade (0.25% STP and 1.0% salt) at 15% PUMP.

Frozen marinated chops from 4 treatments and 1 control were thawed for 24 hour at 36°F. One chop from each treatment (n=5) was cooked on a Taylor clamshell grill. A consumer panel were asked to determine desirability of juiciness, texture, flavor, and overall acceptability of the pork chops during a 2 hour session on three consecutive days (n=135). An 8 point hedonic scale was used where 1=extremely undesirable and 8=extremely desir-

(Continued on page 5)

able.

Marinated ST and CNT chops were cooked as previously described and cook yields determined. Percent cook yield was calculated by determining the difference between the initial and cooked loin chop weight, dividing that difference by the initial weight and multiplying by 100. The cooked loin chops were then chilled at 40°F and Warner-Bratzler shear force subsequently determined. Data was reported in kg of force.

RESULTS

Raw ST and CNT sow loin pH values ranged from 5.38 to 6.81. No significant differences for pH were found between tainted and control loin groups. ST loins (n=17) were randomly selected and evaluated for lipid oxidation (2-thiobarbituric acid test, TBA). Day 1 TBA values ranged from 0.008 to 0.117 indicating minimal lipid oxidation (data not shown).

Subjective color, marbling, and firmness scores for ST and CNT loin chops ranged from 3 to 6 (6 point subjective color scale), 1 to 4 (10 point marbling scale where each number correlates to percent fat), 1 to 3 (3 point firmness scale), respectively (Table 1). Objective L* (lightness), a* (redness), and b* (yellowness) values ranged from 33.13 to 55.73, 18.35 to 24.45, and 0.96 to 8.75 respectively. As the chronological age of animals increases, the quantity of myoglobin in muscle increases resulting in a darker surface color. ST loins were significantly ($P<0.05$) darker than CNT loins for both subjective and objective color (redder and darker).

No differences were found, however, for objective yellowness or subjective marbling or firmness between ST and CNT loins (Table 1). Twenty-four hour purge loss of ST loins (n=34) ranged from 0 and 6.91%. Seven day purge loss for ST loin sections ranged between 0.72 and 9.05%, while 48 hour drip loss ranged from 0.42 to 8.45% for ST loin chops. Twenty-four h, 7 day purge, and 48 hour drip loss were not measured for CNT loins. High purge losses could be attributed to the freezing and thawing process that occurred during shipment and receipt of loins as well as the loin temperatures (35-40°F) observed upon arrival.

Raw moisture, fat, and protein composition for ST and CNT loins ranged between 71.71 to 78.46%, 0.14 to 9.97%, and 20.73 to 26.04% respectively. No significant differences were found between the ST and CNT loins for raw moisture, fat, or protein composition (Table 1).

The pH of marinated ST loin samples was higher than non-marinated raw ST loin pH values (Table 2). ST loins marinated with TRT 1 (0.50% STP, 0.70*M* BICARB) and TRT 2 (0.25% STP, 0.70*M* BICARB) had significantly higher ($P<0.05$) pH values than ST loins marinated with TRT 3 (0.50% STP, 0.35*M* BICARB) and TRT 4 (0.25% STP 0.35*M* BICARB). The CNT loins (0.25% STP) had significantly lower ($P<0.05$) pH values (Table 3). This could be explained by the percent STP and BICARB concentration present in each treatment marinade formulation. STP increases pH values while BICARB has excellent pH buffering properties. This suggests that BICARB and STP collectively increases pH values in comparison to either STP or BICARB individually.

Marinated ST loin sample TBA values measured during consumer sensory panel evaluation ranged from 0.012 to 0.019 indicating that lipid oxidation would have minimal impact on sensory panel scores. No differences were found between marinated ST loins and marinated CNT loins (Table 3). The low TBA values may be due to vacuum packaging and a short frozen storage period (7 days) between loin chop fabrication and sensory evaluation.

No significant differences were found between any marinated treatments for moisture and fat. However, ST loins marinated with TRT 3 were significantly ($P<0.05$) higher in protein than the control loins. No other differences for protein were observed between treatments (Table 2).

Cook yields of ST and CNT loin chops are reported in Table 3. Cook yields for ST loins marinated with TRT1 were significantly ($P<0.05$) higher than all other treatments and the control. TRT 4 loin chop cook yields were significantly ($P<0.05$) lower than TRT 1 and CNT loin chops. CNT loin chops were significantly ($P<0.05$) lower in cook yields than all marinated ST loin chops. A possible explanation for this is that the controls were marinated with a basic marinade of 0.25% STP and 1.0% salt where all other marinade treatments had STP at either 0.25 or 0.50% and either 0.35 or 0.70*M* BICARB with 1.0% salt.

Most targeted injection levels were within 2.5% after injection; however, control loin batches were nearly 5.0% over the targeted injection weight. This was due to the conformation of the commodity control loin sections as

(Continued on page 6)

they were wider and deeper allowing greater opportunity for the needles to inject the marinade solution into the loins during an injection pass. Extended drain times were required to compensate for overpumping.

ST loin chops marinated with TRT 1 required less force to shear ($P<0.05$) compared to chops marinated with other treatment marinades, including CNT loin chops (Table 3). However, all shear force values were low indicating that all ST and CNT loin chops had acceptable tenderness. TRT 1 and CNT were significantly higher ($P<0.05$) for percent moisture than TRT 2, 3, and 4 while TRT 3 was significantly lower ($P<0.05$) than TRT 4. For fat, TRT 1 was significantly higher ($P<0.05$) than TRT 4 and CNT while lower ($P<0.05$) than TRT 2 and 3. Also, TRT 2 and 3 were significantly higher ($P<0.05$) than TRT 1, 4, and CNT. TRT 4 was significantly higher ($P<0.05$) for protein than all other treatments while TRT 1 and TRT 2 had significantly less ($P<0.05$) protein than TRT 3, 4, and CNT loins (Table 3).

Least squares means of consumer sensory scores (8 point hedonic scale) for flavor (FLAV), texture (TEXT), juiciness (JUICE), and overall acceptability (OVERALL) for marinated ST and CNT loin chops are reported in Table 3. The CNT loin chops were not different ($P>0.05$) for FLAV compared to ST loin chops marinated with TRT 3. However, TRT 3 was not different ($P<0.05$) than TRT 1 or 2. TRT 4 had a significantly ($P<0.05$) lower higher sensory score for FLAV but was not different than TRT 1 and 2. These results indicate that TRT 3 was not different than the control for FLAV.

For TEXT, TRT 4 was significantly ($P<0.05$) lower than ST loins marinated with TRT 3 and the marinated CNT loin chops. No differences were observed ($P>0.05$) for ST loin chops marinated with either TRT 1, 2 or 3 compared to CNT loin chops. Marination with STP and BICARB are thought to be the reason for these results since improvements in texture (tenderness) can be observed by injecting pork with a marinade containing STP. ST loin chops with the TRT 4 marinade had the lowest TEXT score which contained the lowest percent STP (0.25%) and BICARB concentration (0.30*M*).

No treatments were different than the control for JUICE. However, TRT 2 and 3 loin chops were juicier ($P<0.05$) than TRT 4 loin chops. These observations indicate that juiciness is a direct result of improved water holding capacity from the addition of phosphates, sodium chloride and sodium bicarbonate.

Least squares means for OVERALL show that TRT 1, 2, and 4 had significantly ($P<0.05$) lower sensory scores than the control. Additionally, TRT 4 had a significantly ($P<0.05$) lower sensory score than TRT 4. However, TRT 3 was not different than the control, indicating its similar consumer acceptability compared to CNT chops. Although significant differences existed among loin chops treated with various marinade solutions it was observed that mean sensory attribute responses were less than 1 hedonic point from the control responses. This indicates that none of the treatments yielded significantly different sensory scores than the control loin chops for any of the sensory attributes evaluated. These results showed that all marinade treatments provided a positive sensory response when applied to sow loins possessing atypical aromas and flavors.

CONCLUSIONS

The focus of this research was to eliminate or reduce the detection of atypical aromas and flavors in sow loins. The consumer acceptability of ST sow loins marinated with various combinations of STP and BICARB was determined. ST loins marinated with 0.50% STP and 0.35 *M* BICARB at 15% PUMP (TRT 3) had comparable sensory attribute scores compared to CNT marinated loin chops (0.25% STP/15% PUMP) for FLAV and OVERALL. It was noted that marinated (TRT 3) ST loin chops exhibited additional improvements in consumer textural and juiciness sensory scores. The potential exists to inject sow meat possessing atypical aromas and flavors with a solution of sodium tripolyphosphate, sodium bicarbonate and salt to minimize or mask the presence of sow taint.

Acceptable pork can be produced from ST sow loins by injecting a marinade of salt, STP (0.50%) and BICARB (0.70 *M*). However, additional quality problems such as variable loin sizes (length, width, loin eye area) and darker lean surface color must be addressed if marketed at the retail level.

ACKNOWLEDGEMENTS: This research was financially supported by Sara Lee Foods.

REFERENCES: Sindelar, J.J. 2002. 2002. Strategies to Eliminate Atypical Aromas and Flavors in Sow Loins. Master's Thesis, Michigan State University.

(Tables 1, 2, & 3 on page 7)

(Continued on page 7)

Table 1

Least squares means for subjective color, marbling, and firmness; objective color (L*, a*, b*) values; raw composition; and pH for sow loins possessing atypical aroma and flavor (sow taint, ST), and non-tainted control commodity loins (CNT).

Loin Type	SUBJECTIVE MEASUREMENTS[c] COLOR	MARB[e]	FIRM[f]	OBJECTIVE COLOR[d] L*	a*	b*	RAW COMPOSITION MOIST[g] %	FAT %	PROT[h] %	pH[i]
ST[a]	4.32l	2.21	2.15	44.25l	21.09	5.14l	75.98	2.42	23.58	5.79
SEM[l]	0.11	0.10	0.06	0.75	0.24	0.53	0.28	0.38	0.18	0.04
CNT[b]	3.50[n]	2.25	2.17	52.51[n]	20.41	6.50[n]	75.51	2.07	24.48	5.89
SEM[m]	0.26	0.25	0.15	1.78	0.57	0.53	0.67	0.90	0.43	0.11

[a] ST = Sow loins with atypical aroma and flavor (sow taint).
[b] CNT = Non-tainted control commodity loins.
[c] Measurements according to National Pork Producers Pork Quality Standards (Baas et al., 2000).
[d] Commission International D'Edairerage (CIE) L*a*b*, where L* = lightness, a* = redness, and b* = yellowness on a 0-100 pink scale.
[e] MARB = Marbling.
[f] FIRM = Firmness.
[g] MOIST = Moisture.
[h] PROT = Protein
[i] pH = Raw pH measurement.
[j] SEM = Standard error of the means for ST loins.
[k] SEM = Standard error of the means for CNT loins.
[l-n] Means within same column with different superscripts are different ($P<0.05$).

Table 2

Least squares means for lipid oxidation (TBA), pH, cook yield, shear force and proximate composition for sow loins possessing atypical aroma and flavor (sow taint, ST), and non-tainted control commodity loins (CNT) marinated at 15% PUMP[b] with STP[c] and BICARB[d].

TRT[a]	TBA[f]	pH[g]	MARINATED COMPOSITION Moisture %	Fat %	Protein %	COOKED COMPOSITION Moisture %	Fat %	Protein %
1	0.019	7.52[i]	76.97	1.94	21.54[i]	74.23[i]	4.29[j]	22.33[k]
2	0.017	7.58[i]	76.69	2.80	20.50[j]	72.29[jk]	5.77[i]	22.73[k]
3	0.012	6.80[j]	77.30	1.86	21.66[i]	71.73[k]	6.47[i]	24.33[j]
4	0.017	6.70[j]	77.89	1.73	21.54[i]	73.09[j]	2.74[k]	26.15[i]
CNT[e]	0.016	6.13[k]	77.82	2.71	20.00[k]	74.62[i]	3.09[k]	23.86[j]
SEM[h]	0.004	0.08	0.72	1.02	0.32	0.21	0.19	0.19

[a] TRT = Treatment combination.
[b] PUMP = Percentage of marinade solution injected.
[c] STP = Sodium tripolyphosphate.
[d] BICARB = Sodium bicarbonate.
[e] CNT = Non-tainted control commodity loins.
[f] TBA = 2-Thiobarbituric acid test for marinated composite samples. Reported as mg malonaldehyde/kg sample.
[g] pH = Marinated pH of composite sample.
[h] SEM = Standard error of the means for treatment combinations and CNT.
[i-k] Means within same column with different superscripts are different ($P<0.05$).

Table 3

Least squares means for cook yield and shear force, and scores for sensory attributes of flavor, texture, juiciness, and overall acceptability of sow loins possessing atypical aroma and flavor and non-tainted commodity control (CNT) loins marinated at 15% PUMP[b] with STP[c] and BICARB[d].

TRTa	MARINADE FORMULATION PUMP %	STP %	BICARB *M*	CY[f] %	SHEAR[g] kg	SENSORY ATTRIBUTES[h] FLAVOR	TEXTURE	JUICINESS	OVERALL[i]
1	15	0.50	0.70	94.98[k]	1.72[m]	5.59[lm]	5.46[kl]	5.67[kl]	5.43[lm]
2	15	0.25	0.70	93.03[kl]	2.19[lm]	5.67[lm]	5.56[kl]	5.99[k]	5.45[lm]
3	15	0.50	0.35	91.70[kl]	2.37[l]	5.87[kl]	5.79[k]	5.98[k]	5.70[kl]
4	15	0.25	0.30	88.57[lm]	2.89[k]	5.44[m]	5.14[l]	5.57[l]	5.15[m]
CNT[e]	15	0.25	0.00	81.58[n]	2.17[lm]	6.14[k]	5.90[k]	5.92[kl]	5.97[k]
SEM[j]				1.22	0.25	0.12	0.14	0.12	0.13

[a] TRT = Treatment combination.
[b] PUMP = Percentage of marinade solution injected.
[c] STP = Sodium tripolyphosphate.
[d] BICARB = Sodium bicarbonate.
[e] CNT = Non-tainted control commodity loins.
[f] CY = Cook yields of loin chops.
[g] SHEAR = Shear force values measured in kg of force.
[h] SENSORY ATTRIBUTES = Consumer panel scores using an 8 point hedonic scale where 1= extremely undesirable, 8= extremely desirable.
[i] OVERALL = Overall acceptability.
[j] SEM = Standard error of the means for treatment combination (1-4) and CNT chop sensory scores.
[k-n] Means within same column with different superscripts are different ($P<0.05$).

Pork Quarterly

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   Michigan State University
   (517) 355-8398

4. **Barbara Straw, Extenstion Swine Veterinarian**
   Michigan State University
   (517) 353-9831

5. **Roy Kirkwood, Extenstion Swine Veterinarian**
   Michigan State University
   (517) 432-5198

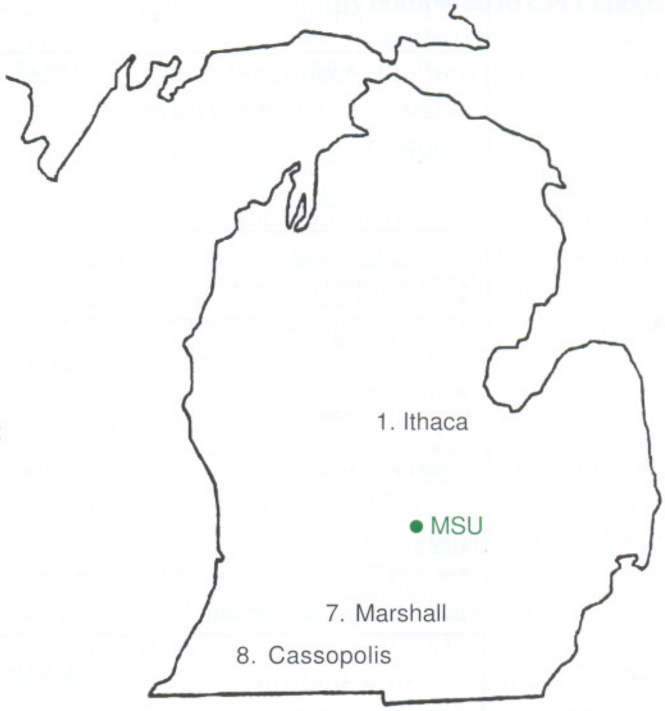
6. **Laura Cheney, Extension Livestock Economist**
   Michigan State University
   (517) 432-0089

7. **Roger Betz, Southwest District Farm Mgt.**
   Finance, Cash Flow, Business Analysis
   (616) 781-0784

8. **Sarah Pion, Southwest Swine Agent**
   Nutrition and Management
   (616) 445-8661

All comments and suggestions should be directed to:

MICHIGAN STATE UNIVERSITY EXTENSION



Production/Marketing Seminar for Michigan's Pork Producers

With changing market conditions within the swine industry, many independent pork producers are seeking ways to capture more value for the pork produced on their farms. Therefore, this program is designed to provide current information on alternative production and marketing opportunities for Michigan's swine producers.

Two Locations Available!

April 9, 2003
Saginaw Valley State University
Curtis Hall, Seminar Room D
Saginaw, MI
5:00 p.m. to 8:00 p.m.

April 10, 2003
Dearth Center
Branch County Fairgrounds
Coldwater, MI
5:00 p.m. to 8:00 p.m.

For More Information, Please Contact:
Sarah Pion, MSUE Southwest MI Swine Agent, 269-445-8661 ex. 26
or
Jerry May, MSUE North Central MI Swine Agent, 989-875-5296

Cost is $20.00 per farm plus $10.00 for each additional person (payable at the door)

Register By Calling *(Before April 4th)*
Gratiot County MSU Extension, 989-875-5233 ***or*** Cass County MSU Extension, 616-445-8661