The National Food Laboratory, Inc.
6363 CLARK AVENUE, DUBLIN, CALIFORNIA 94568-3097
(925) 828-1440

MW7166

November 20, 2006

Mr. Carl Knueven
Jones-Hamilton Company
30354 Tracy Road
Walbridge, Ohio 43465

cknueven@jones-hamilton.com
Phone: (419) 662-5277

Dear Carl,

We have completed the evaluation of the heat resistance of *C. sporogenes* in pea puree under various pH conditions. A report summarizing methods used and results obtained is attached.

If you have any questions about the report please do not hesitate to contact me at 925-551-4259. It has been a pleasure working with you, and I look forward to working again with you soon. Thank you for calling The NFL.

Sincerely,

Amanda Lathrop, Ph.D.
Senior Microbiologist
Process Research & Microbiology Division

EVALUATION OF *C. SPOROGENES* PA3679 HEAT RESISTANCE IN PEA PUREE pH ADJUSTED WITH SODIUM ACID SULFATE

For

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Prepared by

Amanda Lathrop, Ph.D.
Senior Microbiologist
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BACKGROUND:

Bacterial spore heat resistance (D-value) and recover of injured spores is influenced by pH. Jones-Hamilton Company manufactures sodium acid sulfate, an acidulant which lowers the pH of foods without the sourness imparted by other types of acidulants. Jones-Hamilton Company wants to determine to what extent pH affects the heat resistance of spores in a thermally processed model matrix. This information will enable Jones-Hamilton to demonstrate to food manufacturers the potential of using sodium acid sulfate to lower F-value requirements in low-acid food systems.

OBJECTIVES:

To evaluate the heat resistance of *C. sporogenes* in a pea puree unadjusted (pH 7.0) and adjusted to pH 5.8, 5.3, and 4.8.

SUMMARY:

Endpoint-type experiments revealed that product pH has a profound effect on the heat resistance of *C. sporogenes* in split pea soup. The estimated D_{240} for *Clostridium sporogenes* in pea puree at pH 7.0, 5.8, 5.3 and 4.8 was 2.72 min, 1.63 min, 0.82 min and 0.10 min, respectively.

MATERIALS AND METHODS:

Product: pHase™ (sodium acid sulfate) was supplied by Jones-Hamilton Co. Frozen Peas (Trader Joe's Fresh Harvest Petite Peas) were purchase from a local supermarket. Pea puree was prepared in bulk by combining 1000 g of peas with 800 ml of sterile water. Pea puree was pH-adjusted with a 10% pHase™ aqueous solution.

Spore Crop: The NFL provided *C. sporogenes* PA3679 (D_{250} = 0.787 min, z-value 18.8 °F).

Evaluation of Heat Resistance

Uninoculated pea soup was dispensed into TDT cans (12 g/can) and a suspension of spores was added to provide approximately 3.5×10^4 spores/can. A vacuum of 23 lbs was applied to the cans, and cans were sealed. Product was heated in a TDT retort (240°F) at 11 time intervals (10 replicates per interval). Temperature data were collected at the time of heating using thermocouples inserted into TDT cans containing product. Samples were pulled at cumulative lethalites equal to:

pH 6.9
0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5, 30.0, 32.5, 35.0, 37.5 min.

pH 5.8
0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0 min

pH 5.3
0, 2.0, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 7.0, 8.0, 9.0 min

pH 4.8
0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5 min

Incubation/Sampling: After heating, TDT cans were incubated at 30°C for up to 42 days. During the incubation period, cans were checked regularly for swelling indicative of spoilage. Upon signs of spoilage the cans were opened and growth of the test organism was confirmed by odor and microscopically.

D-Value Estimation: For endpoint data, log reduction was calculated by means of a spreadsheet using the Halvorson-Ziegler formula.

RESULTS AND DISCUSSION:

Detailed results for heated *C. sporogenes* inoculated pea soup samples are presented in the Appendix table. The initial inoculum load for all samples was approximately 3.5×10^4 spores/container. The Halvorson-Ziegler formula was used to calculate log reduction. The D_{240} was then estimated by dividing the time interval by the corresponding log reduction. The estimated D_{240} in Pea puree at pH 7.0, 5.8, 5.3 and 4.8 was 2.72 min (15.0 min / 5.52 logs), 1.63 min (9.0 min / 5.52 logs), 0.82 min (4.5 min/ 5.52 logs) and 0.10 min (0.5 min / 4.84 logs), respectively. The estimated D_{240} at pH 7.0 was thus about 27 times as long as the D_{240} at pH 4.8.

Results demonstrate that *C. sporogenes* spores become less heat resistant in pea puree as the pH decreases. We used an organism with (in steam) D_{250} = 0.787 min, z-value 18.8 °F. This organism would have a calculated D_{240} = 2.68 min in steam. The values for this spore crop's heat resistance in pea puree unadjusted (pH 7.0) compare favorably with heat resistance in steam. Results of experiments performed in pea puree suggest that the effect of pH is not incremental. Heat resistance decreases substantially more when pH is lowered from 5.3 to 4.8 than it does when pH is lowered from 5.8 to 5.3.

CONCLUSION:

C. sporogenes spores are substantially less heat resistant in pea puree at pH 7.0 than at 4.8.

Appendix

Results of endpoint experiments in pea puree at indicated pH levels.

Formulation	Interval Time	Nonsterile (out of 10)	Log Count Reduction	Interval D-Value (minutes)	Formulation D-Value (minutes)
	0	10			
	12.5	2	5.20	2.41	
	15.0	1	5.52	2.72	
	17.5	0			
	20.0	0			
pH 7.0	22.5	0			**2.72**
	25.0	0			
	27.5	0			
	30.0	0			
	32.5	0			
	35.0	0			
	37.5	0			
	0	10			
	7.0	0			
	8.0	0			
	9.0	1	5.52	1.63	
	10.0	0			
pH 5.8	11.0	0			**1.63**
	12.0	0			
	13.0	0			
	14.0	0			
	15.0	0			
	16.0	0			
	17.0	0			

Results of endpoint experiments in pea puree at indicated pH levels.

Formulation	Interval Time	Nonsterile (out of 10)	Log Count Reduction	Interval D-Value (minutes)	Formulation D-Value (minutes)
	0	10			
	2.0	9	4.18	0.48	
	3.0	4	4.82	0.62	
	3.5	1	5.52	0.63	
	4.0	0			
pH 5.3	4.5	1	5.52	0.82	**0.82**
	5.0	0			
	5.5	0			
	6.0	0			
	7.0	0			
	8.0	0			
	9.0	0			
	0	10			
	0.5	4	4.84	0.10	
	1.0	0			
	1.5	0			
	2.0	0			
pH 4.8	2.5	0			**0.10**
	3.0	0			
	3.5	0			
	4.0	0			
	4.5	0			
	5.0	0			
	5.5	0			