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Nutritional Composition and Marketable Shelf-Life of Blood Ark Clams and Ponderous Ark Clams[1]

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Introduction

The rapid growth of Florida's hard clam industry over the past decade has motivated aquaculturists to explore alternative molluscan species, which could reduce exposure to production risks and simultaneously promote market expansion. Species diversification could possibly provide some degree of protection against potential disastrous losses associated with a monoculture-based industry. Further, production of other molluscan species could potentially increase sales and profitability, expanding clam consumers' options. The Blood Ark (*Anadara ovalis)* and the Ponderous Ark (*Noetia ponderosa*) clams represent two possible production opportunities.

The overall objective of this study was to determine the market potential of Blood Ark and Ponderous Ark clams in the United States. The study was conducted in three phases during 2003 and 2004. The major focus of Phase I was to assess the market situation for the two types of clams, specifically to determine the trade's knowledge about them and attitudes toward handling them if adequate supplies were available. In Phase II, firms identified in Phase I as potential marketers of these clams were asked to evaluate basic product characteristics of live samples, including appearance, taste, aroma, and textural properties, and to estimate potential sales through their respective firms. Detailed results concerning Phase I and Phase II procedures, findings, and conclusions can be found in EDIS publication FE478, Marketing Opportunity for Blood Ark Clams and Ponderous Ark Clams (http://edis.ifas.ufl.edu/FE478), and the complete report can be found on the website of the Florida Agricultural Market Research Center under Publications, Market Research Publications, 2000-present (Marketing Opportunties for Two Ark Clam Species). The online address is http://www.agmarketing.ifas.ufl.edu.

Phase III determined the nutritional composition of each species and the shelf life under typical commercial refrigeration. Comparisons were also made to the cultured hard clam, *Mercenaria mercenaria*.

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Phase III Findings: Nutritional Composition of Ark Clams

Comprehensive nutritional analyses were conducted for the Blood Ark and Ponderous Ark clam species and compared with the cultured hard clam. Samples of cultured ark clams were collected from their respective growing areas in St. Augustine (east coast of Florida) and Cedar Key (west coast of Florida). One hundred gram samples of meat (wet weight) were shucked for each ark clam species and delivered in coolers to an accredited private food-testing laboratory in Gainesville, Florida. Official methods were used following the AOAC (Association of Official Analytical Chemists) Official Methods of Analysis (Horwitz, 2002).

The nutrition facts and labeling for cultured Blood Ark clams were determined for a serving size of 100 grams of raw, edible portion. This serving is low in calories (35) and total fat (0.5 g), and high in protein (7 g). Cholesterol is relatively low (35 mg), with the serving portion representing 12 percent of the daily value. There is no detectable carbohydrate (0 g) in this portion. In terms of percent daily value, a serving of Blood Ark clams provides six percent of Vitamin A, two percent of Vitamin C, and six percent of calcium. Blood Ark meats are high in iron (70 percent of daily value), which is most likely associated with the presence of hemoglobin and erythrocytes in the clam meats. Of note is the high sodium content (740 mg), which represents 31 percent of the daily value. Even for a saltwater mollusk, this level is particularly high (Table 1). One plausible explanation for this may be that the meat sample (wet weight) contained fluids from within the shell. These trapped fluids may have abnormally increased the sodium content.

The nutrition facts and labeling for cultured Ponderous Ark clams were also determined for a serving size of 100 grams of raw, edible portion. Like the Blood Ark clams, this serving is low in calories (50) and total fat (1 g), and even higher in protein (11 g). The cholesterol level for Ponderous Ark clams (55 mg) is higher than in the Blood Ark sample, representing 18 percent of the daily value. There is little carbohydrate (1 g). In terms of percent daily value, a serving of Ponderous Ark clams provides six percent of Vitamin A, four percent of Vitamin C, and ten percent of calcium. Ponderous Ark meats are also high in iron (50 percent of the daily value), again most likely associated with the blood pigment content. Although the sodium content (480 mg) is lower than that for the Blood Ark clams, it is still relatively high, representing 20 percent of the daily value (Table 1).

A nutritional analysis for the hard clam was obtained from the Florida Department of Agriculture and Consumer Services, Bureau of Seafood and Aquaculture Marketing. Approximate nutritional values for four ounces (114 g) of raw, edible portion were converted to 100-gram equivalents, and resulting values are as follows: Calories (70), Calories from fat (9), Total Fat (0.9 g), Saturated Fat (0 g), Cholesterol (40 mg), Sodium (57 mg, or 2 percent of the Recommended Daily Intake (RDI)), Carbohydrate (0 g), Protein (16 g), Calcium (4 percent of RDI), and Iron (20 percent of RDI). Information on Vitamin A and Vitamin C values was unavailable (Table 1).

In comparison to the two species of ark clams, the hard clam is slightly higher in calories and protein, but similar in total fats, cholesterol, and total carbohydrate. Greater differences between the hard clam and ark clams are found in the iron and sodium values. Ark clams provide two to three times the daily percent values for iron than do hard clams, whereas ark clams contain ten times the amount of sodium than do hard clams.

Phase III Findings: Shelf Life of Ark Clams

Molluscan shellfish are typically shipped as live shellstock and adequate shelf life is an important product attribute. Federal regulations require that live mollusks be placed in refrigerated storage (<45°F) within a predetermined time/temperature harvest matrix to reduce probable levels of *Vibrio* bacteria (FDA, 2003). For these reasons, the shelf life of live Blood Ark and Ponderous Ark clams was investigated to assure product quality and safety.

To determine the survival of these two ark clam species in refrigerated storage, an evaluation of shelf life was conducted in April 2004. Procedures

followed those developed by Applewhite et al. (1996) and Otwell (1998) for determining shelf life of hard clams. Blood Ark clams were harvested from a commercial shellfish aquaculture lease located in the Intercoastal Waterway on the east coast of Florida at 8:00 AM on March 31, 2004. Ponderous Ark clams were harvested from a commercial lease in the Gulf of Mexico on the west coast of Florida at 9:00 AM on the same day. Bottom water temperatures at the time of harvest were recorded. Immediately post-harvest, ark clams were transported in coolers under ambient conditions to the Florida Fish and Wildlife Conservation Commission's marine laboratory in Cedar Key. At 1:00 PM ark clams were received at the laboratory and placed under tempering conditions at 68°F following protocols defined in the National Shellfish Sanitation Program, Model Ordinance, Guide for the Control of Molluscan Shellfish, VIII@.03 OPTION 1.E (FDA, 2003) and the Comprehensive Shellfish Control Code, Rule Chapter 5L-1.013(3)(b), Florida Administrative Code (FAC). During tempering, 100 ark clams were randomly selected from each species, of which a sub-sample of 25 was measured and weighed. Each ark clam sample of 100 was then placed into polyethylene tubular netting, which is typically used by shellfish dealers in bagging and transporting hard clams.

As defined in the harvest time/temperature matrix per Rule Chapter 5L-1.008(5), FAC, molluscan shellfish must be placed into refrigeration within 12 hours of the time of harvest during the month of April. If tempering is included as an alternative post-harvest process, then the time to refrigeration can be extended up to 16 hours from the time of harvest. Ark clams were placed into a thermostat-controlled refrigerator set at the standard storage temperature of 45°F on March 31 at 7:30 PM. Air temperatures were recorded inside the refrigerator using a minimum/maximum thermometer. The ark clams were checked daily for survival with the exception of two days during the evaluation period. Gaped ark clams were determined to be “commercially dead” when they did not respond by closing their shell to specified agitation, or tapping, after the ark clams were held for a short time at room temperature. Dead ark clams were counted and removed from the sample bags. The general conditions of the ark clams during storage were also noted. The evaluation was conducted until 50 percent of the Blood Ark clams died. At that time, percent survival was also determined for Ponderous Ark clams.

Water temperature at the time of harvest of the Blood Ark clams was 67°F. The clams used in the Blood Ark sample averaged 1 7/8” in shell length, 1 1/4” in shell width and 12.6 clams per pound. During the shelf-life evaluation, minimum air temperatures in the refrigerator averaged 41.4°F (+/-3.3°F) and maximum air temperatures averaged 52.4°F (+/-2.5°F). The overall average daily temperature was 46.9°F (+/-2.7°F). The noncommercial refrigerator used in this study was not able to maintain air temperatures consistently below 45°F.

The first Blood Ark mortality occurred on the fourth day of the evaluation. Mortalities were not noted again until the tenth day when five Blood Ark clams did not respond to agitation. Mortalities then occurred almost daily, with the number of mortalities increasing rapidly after the 19th day. On Day 23, the cumulative number of dead Blood Ark clams was 57 and the shelf-life evaluation was terminated.

Survival of Blood Ark clams in refrigerated storage was 99 percent or greater during the first nine days of the evaluation. Survivals dropped below 90 percent and 50 percent after Days 13 and 23, respectively. After the first week of the evaluation, liquid began accumulating in the bottom of the tray holding the Blood Ark bag. The tray was wiped clean daily thereafter. In addition, gaping occurred frequently in the live Blood Ark clams and agitation was required before they would close. The remaining live ark clams at the end of the evaluation sounded “hollow” and a strong odor was detected. A commercial mortality of greater than five percent would be considered unacceptable by the shellstock shipper industry, thus the shelf life of Blood Ark clams harvested under spring conditions may be limited to ten days. During warmer water temperatures experienced in summer months, shelf life may be further reduced, thus limiting shipment of live Blood Ark clams during that time period.

Water temperature at the time of harvest of the Ponderous Ark clams was 68°F. The clams used in the Ponderous Ark sample averaged 2” in shell

length, 1 3/8" in shell width and 10.5 clams per pound. The shelf life evaluation for the Ponderous Ark clams was conducted simultaneously and in the same non-commercial refrigerator that was used for the Blood Ark clams. Thus the temperatures for the Ponderous Ark shelf life evaluation were identical to those reported above for the Blood Ark clams.

The first Ponderous Ark mortality occurred on Day 23 of the evaluation. This was the same day that the Blood Ark evaluation was terminated because over 50 percent of the Blood Ark clams had died. It was decided to end the Ponderous Ark evaluation on the same day.

Survival of Ponderous Ark clams in refrigerated storage was 100 percent during the first 22 days of the evaluation. On Day 23, the first mortality occurred, dropping the survival rate to 99 percent. The majority of the Ponderous Ark clams remained tightly closed throughout the evaluation with no liquid accumulating on the bottom of the tray holding the Ponderous Ark bag. There was no gaping observed in the remaining live ark clams and no odors were detected.

A baseline for the survival of Florida farm-raised hard clams during refrigeration was obtained for product harvested from commercial aquaculture leases in the Gulf of Mexico during April through October 1997 (Otwell, 1998). In April, 100 percent of the hard clams survived for seven days after placement in refrigerated storage. After ten days, the survival of hard clams dropped to 90 percent. In this study, the Blood Ark clams showed similar responses to refrigerated storage as hard clams. It may be that like hard clams, survival of Blood Arks may be reduced when harvested during the warmer summer months. However, extending the tempering protocol to its full duration of 16 hours may help prolong the refrigerated shelf life of Blood Arks as it has with hard clams. The tolerance of live Ponderous Ark clams to refrigerated temperatures exceeds that observed for hard clams and other molluscan shellfish, such as oysters.

Summary

In summary, like the hard clam and other molluscan shellfish, ark clams are an excellent source of protein and especially good source of iron and calcium. However, based on these results consumers who must restrict their intake of sodium should take these nutritional facts into consideration or reduce their portion size. These results demonstrate that commercial distribution of live shellstock of both ark clam species is achievable. Alternative harvesting, handling and storage techniques, such as tempering, used to increase survival of hard clams in refrigerated storage when harvest water temperatures exceed 80°F should also be considered for the Blood Ark clam.

References

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Table 1. Nutrititional composition of Blood Ark, Ponderous Ark, and Hard Clams.

Nutritional Parameter	Type of Clam		
	Blood Ark Clam (*Anadara ovalis*)	Ponderous Ark Clam (*Noetia ponderosa*)	Hard Clam (*Mercenaria mercenaria*)
	----------Values per 100-gram portion[a]----------		
Calories	35	50	70
Calories from fat	N/A	N/A	9
Total fat (grams)	0.5	1	0.9
Saturated fat (grams)	N/A	N/A	0
Protein (grams)	7	11	16
Cholesterol (milligrams)	35	55	40
Carbohydrates (grams)	0	1	0
Sodium (milligrams)	740	480	57
Percent of RDI[b]			
Cholesterol	12	18	13
Vitamin A	6	6	N/A
Vitamin C	2	4	N/A
Calcium	6	10	4
Iron	70	50	20
Sodium	31	20	2

N/A = Not available
[a] Values for hard clams were derived from 114-gram (4-ounce) portions (Florida Department of Agriculture)
[b] RDI = Recommended Daily Intake.