

## **2002 MAFMA Final Report**

Project Title           **Efficacy of dry edible beans to inhibit breast cancer**

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### **1. Objective Summary**

Black beans inhibited the development of breast cancer while navy beans only slightly inhibited tumorigenesis and light red kidney beans did not inhibit breast cancer at all.

### **2. Objective Accomplishments**

The research objectives were accomplished, i.e., the efficacy of dry edible beans to inhibit breast cancer was determined.

### **3. Unexpected findings, if any**

None

### **4. Practical impacts of research efforts.**

The dry bean industry is using this and other anti-cancer work by the PI to promote the health benefits of beans nationally and internationally. The PI plans to determine if beans will inhibit the development of prostate cancer.

### **5. If you are also making reports to other funding agencies in the course of this research work, please include a copy of that report.**

This report will be submitted to The Bush Brothers Co.

## MATERIALS AND METHODS

*Animals and housing:* Female Sprague Dawley rats (21 days old) were obtained from Harlan Sprague-Dawley (Indianapolis IN). They were housed three per plastic cage with sawdust bedding and were assigned to treatment groups by weight. The animal room was temperature (22-24 °C) and humidity (40%-60%) controlled with a 12 hour off/on light cycle. The rats were given free access to the diet and to distilled water throughout the study. The study was approved by the Michigan State University Committee on Animal Use and Care.

*Diets:* Navy, light red kidney, and black beans, grown in Michigan, were soaked overnight in distilled water at 4 °C and cooked in open kettles until soft. They were then dried in a convection oven at 50-60°C. The dry beans were ground to pass through a screen with 1.6 mm diameter holes prior to mixing with other diet ingredients. Table 1 shows the composition of the diets. All diets provided 18.9% protein, 16.67% fat, 9.5% dietary fiber, and 390 kcal/100g.

Table 1. Diet compositions (g/100g)

	bean	control
Cornstarch	3.21	48.54
Casein	5	20.07
Bean	70	
Sucrose		
corn oil	2.5	2.5
Soy Oil	3	3
Lard	10.38	11.15
Cellulose	0.14	9.1
Mineral mix	3.71	3.71
Vitamin mix	1.06	1.06
Methionine	0.448	0.318
Calcium carbonate	0.25	0.25
Choline bitartrate	0.3	0.3
TBHQ	0.0014	0.0014

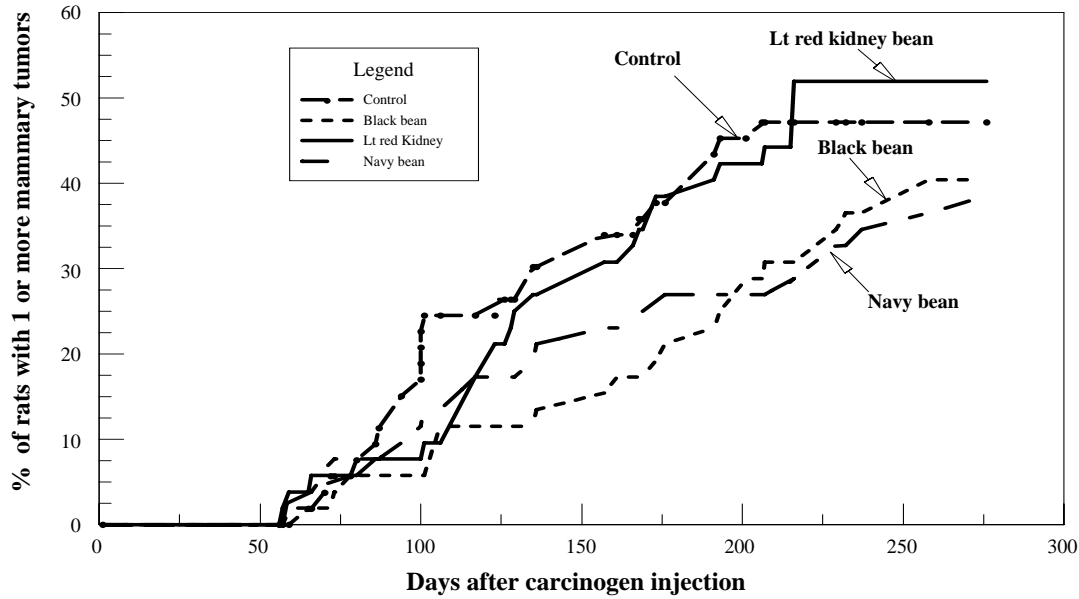
*Administration of carcinogen and monitoring of cancer status:* Mammary cancer was induced by a single subcutaneous injection of 3-methyl-nitrosourea (30 mg/kg) into the flank at 51 days of age. Time dependent appearance and growth of tumors were determined by weekly palpations.

*Necropsy and histology:* When a tumor reached 2.5 cm in diameter or 330 days after carcinogen injection, whichever occurred first, the rat was euthanized by CO<sub>2</sub> inhalation and exsanguination. All mammary tumors were excised and processed for histopathological examination using routine histologic procedures. The embedded tissues were sectioned, stained with hematoxylin and eosin, and classified by a pathologist that was blinded to the treatments.

## RESULTS

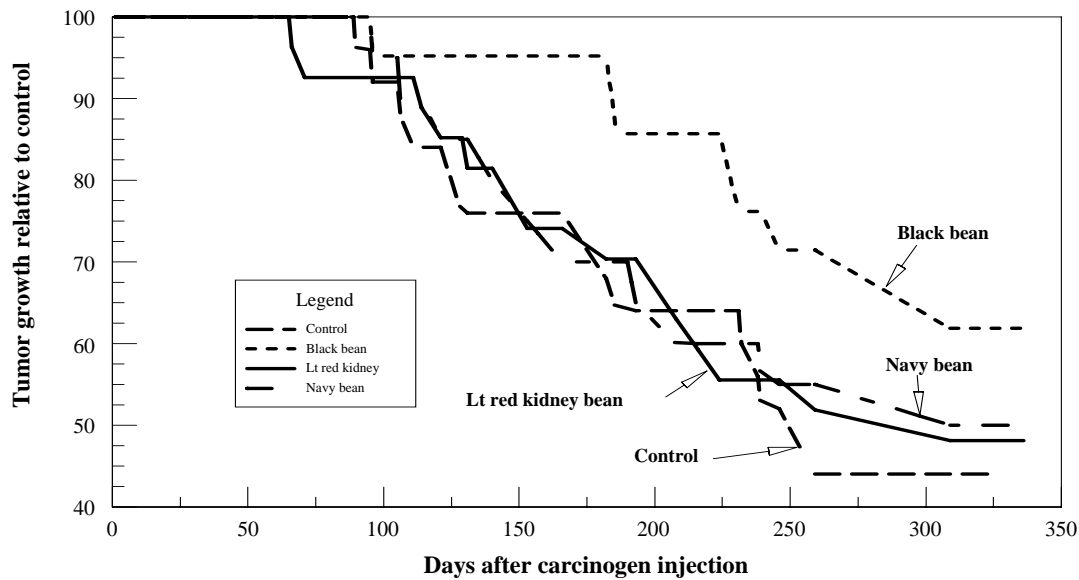
Inhibitors were completely inactivated by cooking and drying (i.e., residual phytohemagglutinin and trypsin inhibitor activity was nil). Rat growth was similar for all diets. Tumor latency is shown in Figure 1. The rate of tumor appearance was similar between rats fed

**Figure 1. Dietary Effect on Tumor Development**



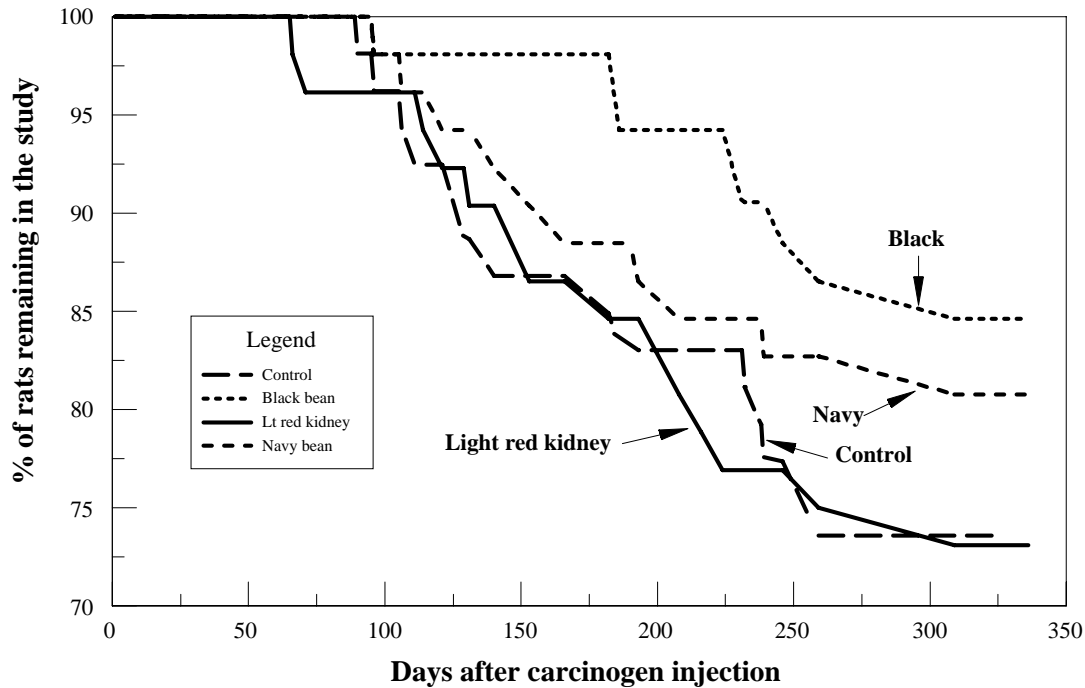
the control diet and the diet with light red kidney beans. Feeding navy or black beans delayed the appearance of tumors. The rate of tumor growth once a tumor developed is shown in Figure 2.

**Figure 2. Index of mammary tumor growth as affected by diet**



Tumors grew more slowly in rats eating black beans whereas tumor growth was similar for rats fed light red kidney beans, navy beans and the control diet. Figure 3 shows the combined effect

**Figure 3. Breast Cancer Survival as Affected by Diet**



of tumor latency and tumor growth. Since both tumor latency and tumor growth were slowed in rats eating black beans, they had a longer survival time (i.e., days until a tumor grew to 2.5 cm in diameter). There was no difference between rats fed the control diet and rats fed light red kidney beans. Rats fed navy beans had a slightly longer survival due to the longer tumor latency.

## CONCLUSIONS

Feeding black beans delayed tumor appearance and slowed the growth of mammary tumors while feeding navy beans delayed the appearance of mammary tumors but did not slow tumor growth. Feeding light red kidney bean did not alter tumor latency or growth compared to the control. The potential for beans to inhibit breast cancer appears to be dependent upon the market class of bean that is consumed.