ultran

redefining
the limits of
ultrasound

ultran laboratories, inc.
1020 East Boal Avenue,
Boalsburg, PA 16827 USA
814 466 6200 phone
814 466 6847 fax

Ultrasonic NDC of Agricultural Products*
(Vegetables & Fruits)

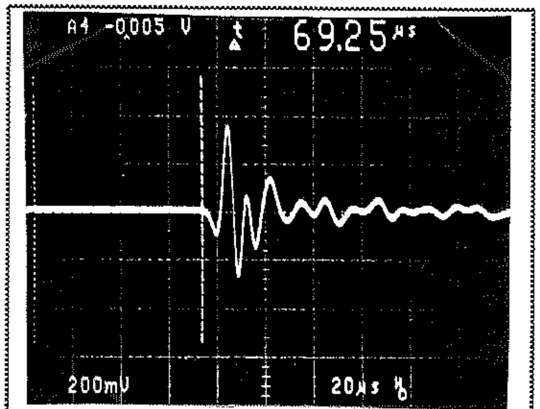
*Performed by HPN-5000 Advanced Ultrasonic System and Novel Transducer Technology

1. INTRODUCTION

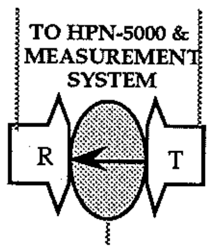
It is now well-established that ultrasound is capable of providing useful processing and applications related information about any material through which it can be propagated.[1] For example, velocities of ultrasound can be directly correlated to density, porosity, humidity, pH, elastic and other properties of isotropic and anisotropic materials. Similarly, frequency-dependence of ultrasonic attenuation/absorption can provide important information about materials microstructure and composotion. Whereas ultrasonic techniques for industrial materials are well-developed, the same isn't true for biological products. These limitations have been greatly overcome by Ultran's 20 years of intense research into the science of ultrasound and development of techniques that can be adapted for the investigation of botanical products.[2]

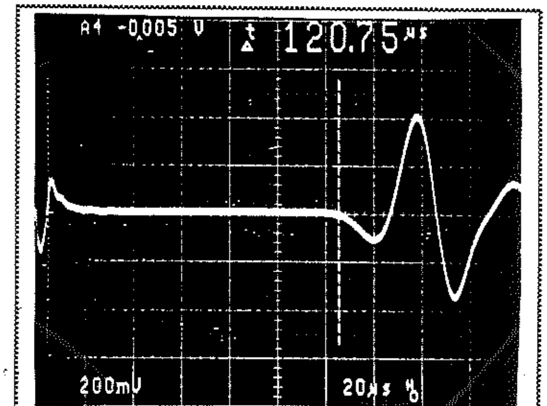
In this short applications note we are pleased to provide the feasibility of NonDestructive Characterization (NDC) of vegetables and fruits - for quality enhancement and good health. **If you are interested in using this application, please contact Ultran.**

2. SELECTED EXAMPLES, OBSERVATIONS, AND TECHNIQUES



RF oscilloscope trace of a transmitted signal from ripe unpeeled potato. Frequency: 250KHz
Technique: Direct Transmission. Velocity: 800m/s





RF oscilloscope trace of a transmitted signal from ripe cut red apple. Frequency: ~100KHz.
Technique: Direct Transmission. Velocity: 140m/s

3. TYPICAL ULTRASONIC CHARACTERISTICS OF SOME COMMON VEGETABLES AND FRUITS

VEGETABLE/FRUIT	CONDITION	VELOCITY (m/s)	REL ATTEN.	OPTIMUM FREQUENCY (range)
Potato (Idaho)	Ripe	800	Low	250KHz to <1.0MHz
Potato (Florida)	Ripe	700	Low	250KHz to <1.0MHz
Apple (Red)	Ripe	150	V. High	<50KHz to 100KHz
Potato (Idaho)	Partly rotten	600	High	50KHz to 250KHz
Yam (N. Carolina)	Ripe	250	V. High	50KHz to 100KHz
Banana (Unpeeled)	Ripe	250	V. High	<50KHz to 100KHz
Banana (Peeled)	Ripe	270	V. High	<50KHz to 100KHz
Carrot (Closer to leaves)	Ripe	550	High	50KHz to 250KHz
Carrot (Middle)	Ripe	600	High	50KHz to 250KHz
Carrot (Deeper in ground)	Ripe	580	High	50KHz to 250KHz
Turnip (Radial)	Ripe	240	V. High	<50KHz to 100KHz
Turnip (Along root)	Ripe	220	V. High	<50KHz to 100KHz
Daikon (Closer to leaves)	Ripe	280	V. High	<50KHz to 100KHz
Daikon (Middle)	Ripe	300	V. High	<50KHz to 100KHz
Daikon (Deeper in ground)	Ripe	370	V. High	<50KHz to 100KHz
Asian Pear (Whole unpeeled)	Ripe	240 (?)	V. High	<50KHz to 100KHz
Asian Pear (Cut)	Ripe	2,600	Low	500KHz to 2MHz
Grape (Seedless, axial)	Ripe	1,800	Low	500KHz to 2MHz
Grape (Seedless, radial)	Ripe	1,300	Low	500KHz to 1MHz

1. *M.C. Bhardwaj, "Evolution, Practical Concepts, and Examples of Ultrasonic NDC," Ceramic Monographs, Interceram 41 (1992) [7/8] #4.5 and 42 (1993) [1] #4.5, Handbook of Ceramics, Verlag Schmidt GmbH, Freiburg, Germany.*
2. *Ultran Laboratories, Inc., "Some Recent Developments in Ultrasonic Sensor and Related Applications Technologies from Ultran," an Ultran Publication U-1093.*

ultran

redefining the limits of ultrasound

ultran laboratories, inc.
1020 East Boal Avenue,
Boalsburg, PA 16827 USA
814 466 6200 phone
814 466 6847 fax

Ultrasonic NDC of Agricultural Products*
(Legume, Nuts, & other Grains)

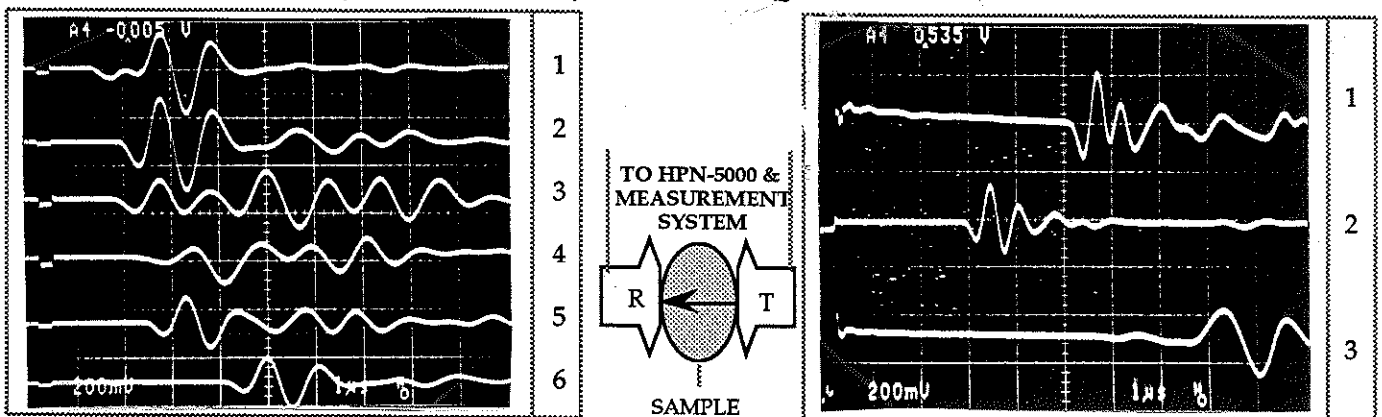
*Performed by HPN-5000 Advanced Ultrasonic System and Novel Transducer Technology

1. INTRODUCTION

It is now well-established that ultrasound is capable of providing useful processing and applications related information about any material through which it can be propagated.[1] For example, velocities of ultrasound can be directly correlated to density, porosity, humidity, pH, elastic and other properties of isotropic and anisotropic materials. Similarly, frequency-dependence of ultrasonic attenuation/absorption can provide important information about materials microstructure and composotion. Whereas ultrasonic techniques for industrial materials are well-developed, the same isn't true for biological products. These limitations have been greatly overcome by Ultran's 20 years of intense research into the science of ultrasound and development of techniques that can be adapted for the investigation of botanical products.[2]

In this short applications note we are pleased to provide the feasibility of NonDestructive Characterization (NDC) of legume, nuts, and other grains - for quality enhancement and good health. **If you are interested in using this application, please contact Ultran.**

2. SELECTED EXAMPLES, OBSERVATIONS, AND TECHNIQUES



RF oscilloscope traces of a transmitted signals from a variety of legumes and other grains

#1. Rice. #2. Split pea. #3. Lentil. #4. Green Moong bean. #5. Mexican black bean. #6. Garbanzo bean.

#1. Peanut. #2. Soyabean. #3. Cashew nut

Frequency: 2MHz. Technique: Direct Transmission DRY COUPLING

3. TYPICAL ULTRASONIC CHARACTERISTICS OF COMMON LEGUME, NUTS, AND OTHER GRAINS

LEGUME/GRAIN	CONDITION	VELOCITY (m/s)	REL ATTEN.	OPTIMUM FREQUENCY (range)
Lima bean (large)	Ripe	2,100	Low	1 to <3MHz
Small white bean	"	1,950	Low	1 to <3MHz
Black eye bean	"	2,700	Low	2 to <5MHz
Northern bean	"	1,700	Low	1 to <3MHz
Pea (split yellow)	"	3,100	Low	2 to >5MHz
Garbanzo bean	"	2,500	Low	1 to <5MHz
Pea (split green)	"	3,100	Low	2 to >5MHz
Lentil	"	3,000	Low	2 to >5MHz
Black bean (Mexican)	"	3,000	Low	2 to >5MHz
Cranberry bean	"	2,800	Low	2 to >5MHz
Kidney bean (red)	"	1,400	High	500KHz to 2MHz
Kidney bean (black)	"	2,300	Low	1 to <5MHz
Moong (green)	"	4,700	V. low	2 to ~10MHz
Urad (black Moong)	"	2,500	Low	2 to <5MHz
Rice	"	1,100	High	500KHz to 2MHz
Peanut (Raw unsplit)	"	1,700	Low	1 to <3MHz
Soyabean	"	2,200	Low	2 to 5MHz
Cashew nut (Raw unsplit)	"	1,500	Low	1 to <3MHz

1. *M.C. Bhardwaj, "Evolution, Practical Concepts, and Examples of Ultrasonic NDC," Ceramic Monographs, Interceram 41 (1992) [7/8] #4.5 and 42 (1993) [1] #4.5, Handbook of Ceramics, Verlag Schmidt GmbH, Freiburg, Germany.*
2. *Ultran Laboratories, Inc., "Some Recent Developments in Ultrasonic Sensor and Related Applications Technologies from Ultran," an Ultran Publication U-1093.*