# Engineering Properties of Biomaterials Lab.

**TITLE :** Study for Nondestructive Detection Algorithm Development of the Internal Browning and Watercore of Fuji Apple Using VIS/NIR Transmittance Spectroscopy

**Author :** Seo, Young Wook

**Year** : 2007

**Journal :** Journal of food engineering

## Abstract

The goal of this study is to develop a non-destructive method to detect internal browning and water-core in Fuji apples by VIS/NIR transmittance spectroscopic method, To acquire the transmitted energy spectra of an apple, a proto-type spectroscopic sensing unit was made with a sample holder, light sources, a real time spectrometer, etc. The apple samples having the internal rots were artificially made. All spectra of the Fuji apple samples showed three peaks near 640nm, 710nm and 800nm, respectively. And the transmitted energy levels of water-core apples were higher than the sound and those of the internally rotted samples were the lowest. Classification tests, which were made with the normalized peak values and peak difference values , indicated that the most efficient classification algorithm is primary to separate out the internally rotted from the give Fuji apples by the peak difference value....

**TITLE :** Real Time Color Calibrations for Color Evaluation

**Author :** H. Lee

**Year    :** 2007
**Journal :** Journal of Biosystems Engineering

**Abstract**

Color evaluation was used long to detect external qualities of farm products. Although wrong determinants due to subjectivity or fatigue of judgers from when the digital camera and computers were used, a problem which the color at digital camera image is different with the real color occurred. Therefore this study made efforts to develop the color evaluation algorithm with  MLR(Multiple Linear Regression)and Bezier fitting for real time color calibrations. And the capacity and process speed were analyzed.

**TITLE :** Discriminant Analysis Internal Quality of "Fuji" Apples Using Transmittance NIR Spectra

**Author :** Y. Seo, S. H. Noh

**Year    :** 2007
**Journal :** Journal of Biosystems Engineering

**Abstract**

The goal of this study is to develop a non-destructive method to detect internal browning and water-core in Fuji apples by VIS/NIR transmittance spectroscopic method, To acquire the transmitted energy spectra of an apple, a proto-type spectroscopic sensing unit was made with a sample holder, light sources, a real time spectrometer, etc. The apple samples having the internal rots were artificially made. All spectra of the Fuji apple samples showed three peaks near 640nm, 710nm and 800nm, respectively. And the transmitted energy levels of water-core apples were higher than the sound and those of the internally rotted samples were the lowest. Classification tests, which were made with the normalized peak values and peak difference values , indicated that the most efficient classification algorithm is primary to separate out the internally rotted from the give Fuji apples by the peak difference value....

**TITLE :** Quality Evaluation of Sugar Contents for Grapes Using NIR Spectroscopy

**Author :** J. R. Son, K. J. Lee, S. W. Kang, Y. W. Seo

**Year** : 2007

**Journal :** Journal of Biosystems Engineering

**Abstract**

 The goal of this study is to develop a on-line non-destructive method to detect sugar content in Campbell Early species by VIS/NIR reflection/transmittance spectroscopic method.

# Lab. for Design of Off-road Equipment Design

## Abstract

 This study was conducted to investigate the effects on the shifting performance of the design parameters of a power shuttle tractor using a computer simulation technique. The EASY 5 models of the hydraulic control system and power shuttle transmission were developed, and combined with a tractor model to complete a simulation model for a power shuttle tractor. The models for the hydraulic control system and power shuttle transmission were verified using an experimental power train constructed for the validation purpose.

The design parameters included the terminal pressure and time for the modulation of the hydraulic control system, and forward speed, weight, shuttle gear ratio and torsional damping of the tractor. The shift performance was evaluated in term of the peak torques of the input shaft of the transmission and tractor axles, and power transmitted per unit area of the clutch and the time required for the power transmission.

**TITLE :** Computer Simulation of Sideways Overturning of Side-Loaded Mini-Forwarder

**Author :** S. B. Shim, Y. J. Park, K. U. Kim, J. W. Kim, M. S. Park,
T. Y. Song.

**Year :** 2007

**Journal :** Journal of Biosystems Engineering

**Abstract**

This study was conducted to evaluate the sideways overturning stability of side loaded mini-forwarder. The model of a prototype was developed using a 3D CAD modeler and the performance was experimentally validated. The prototype modelwas run on the multibody dynamic analysis program, Recurdyn 6.0, to simulate motions when the model traversed over a circular bump on a inclined ground surface. The simulation was performed at a constant forward speed of 1.85 km/h under the loaded and unloaded conditions. The forward direction was also controlled to vary from 0 to 360 degrees with an increment of 10 degrees. Results of the simulation showed safe regions in which the mini forwarder could travel safely in terms of direction and slope of the ground. Even when the mini-forwarder was loaded by 20 logs of 3.6m long and in terms of direction and slope of the ground. Even when the mini-forwarder was loaded by 20 legs of 3.6m long and 12cm diameter, it traveled safely within the ground slopes of 1 to 45 degrees  by directions.

**TITLE :** Reduction of Rattle Noise in a Direct-Engine PTO Driveline Using an Anti-backlash Gear

**Author :** S. B. Shim, Y. J. Park, K. U. Kim

**Year :** 2007

**Abstract**

An anti-backlash gear was developed to reduce the rattle noise generated from the gearbox of a direct-engine PTO driveline of agricultural tractors under idling. A pair of gears using the anti-backlash gear as driven part was modeled and verified. Using the verified model, a computer simulation was conducted to investigate the effect of design parameters of the anti-backlash gear on the reduction if rattle noise. The optimum values of the design parameters were also determined by computer simulation. The optimaized anti-backlash gear was then manufactured and installed on the experimental PTO driveline gear of the PTO gearbox was replaced by the optimized anti-backlash rear. Results of dtudy were as follows:

The optimum values of the design parameters. spring constant and deformation, may be determined by relationship: $k \geq \dfrac{4364.7}{150\delta - 23.564}$ The optimized anti-backlash gear reduced the rattle noise maximally by 16.9dBA. This concluded that it would be most effective to use the optimized anti-backlash gear ti eliminate the rattle noise in the PTO driveline.

## Abstract

This study was conducted to measure and analyze the noise from a combine head. The combine head, comprised of a cutting knife assembly, pick-up chains, horizontally conveying chains and vertically conveying chins, had an overall sound level of 101 dBA. The sound levels of each component were, respectively, 98.3 dBA for the cutting knife assembly, 88.9 dBA for the pick-up chains, 79.8 dBA for the horizontally conveying chains and 86.3 dBA for the vertically conveying chains, being equivalent to 55.4%, 18.4%, 6.5% and 13.7% of the overall head noise. The main cause of the head noise was considered the impacts that the joint of the cutting knife assembly made with frame when it oscillated. The impact sound was also generated when the chain lug collided with the chain casw. To reduce these impact sound, anti-vibration rubbers were installed on the knife assembly joint and the chain cases. It reduced the head noise by 4 dBA but the overall noise level of the combine head was still high. In oder to protect the combine operators more effectively from the noise, a safety cab needs to be installed on the combine.

**TITLE :** Effects of Gear Grade and Anti-backlash Gear on the Rattle Noise of a
Direct Engine-PTO Driveline of Tractors

**Author :** S. B. Shim

**Year :** 2007

**Abstract**

There has been much effort to reduce the rattle noise in the PTO gearbox of an direct-engine PTO driveline of agricultural tractors under idle conditions. This study was also one of such an effort.

The gear sets were classified by a name method of KS B ISO 1328 and An experiment was conducted to investigate the differences in the rattle noise when gears of 4 different grades were used for the PTO gearbox. But there is not close correlation between gear grade and sound pressure level. The difference of the PTO rattle noise among the gears of 4 different grades was at maximum 5 dB(A). The specific items of gear grade were supposed to be caused the difference. So further study will need to be conducted.

Also the development of anti-backlash gear model was conducted to investigate the effect of anti-backlash gear on rattle noise. The result of simulation ,base on the anti-backlash gear model, spring stiffness k had relation to spring deformation the following not to occur the rattle noise. $k \geq \dfrac{4364.7}{(150 \cdot \delta x - 23.564)}$ Design parameters, spring stiffness and spring deformation, were determined using simulation results and the PTO rattle noise was measured to investigate the lowest noise condition one of the 10 different spring stiffness and deformation condition. As a result, the rattle noise was lowest when spring type was TH and spring deformation was 5 mm. Sound pressure level was at 88.8 dB(A) when the rattle noise was lowest.

Compared to test tractor, the rattle noise was reduced to maximum 16.9 dB(A) after using anti-backlash gear. this result was more than 10 dB(A) that was expected. So changing driven gear to anti-backlash gear was a very effective method to reduce the rattle noise.

**TITLE :** Reduction of PTO Rattle Noise of an Agricultural Tractor Using an Anti-backlash gear

**Author :** S. B. Shim, Y. J. Park, K. U. Kim.

**Year** : 2007

**Journal :** Journal of Biosystems Engineering

**Abstract**

An anti-backlash gear was developed and tested as a PTO rattle noise reducer for a direct-engine PTO driveline of agricultural tractors. Models of the anti-backlash gear and its driving gear were developed and used to simulate the relative angular displacement between them when idling. Computer simulations were also conducted to determine the minimum initial load of the anti-backlash gear for zero relative angular displacement. Performance simulation of the anti-backlash gear with different spring stiffness and initial deflections indicated that the PTO rattle noise by the impact could be eliminated by zero relative angular displacement and that rattle noise could be further decreased by increasing spring stiffness. In experiments the anti-backlash gear reduced the rattle noise by 11.4−16.9 dBA depending on the spring stiffness with zero relative angular displacement. A relationship between the stiffness and initial deflection of the spring is proposed for zero relative angular displacement. It is concluded that anti-backlash gear can reduce effectively the PTO rattle noise of the direct-engine PTO driveline of agricultural tractors when idling.

**TITLE :** Development of a Precision Seed Drill for Oilseed Rape

**Author :** Ebrahim Ahmadi, Hamid Reza Ghassemzadeh, Mohammad Moghaddam, Kyeong Uk Kim

**Year :** 2008

**Journal :** Journal of Biosystems Engineering

**Abstract**

At the present time, the most widely used machine for seed and oilseed planting is a seed drill with a roller-type-metering device. Due to non-uniform spacing of seeds along the rows and lack of control on planting depth, this machine aggravates the growth related problems and degrades the quality of a sensitive crop such as oilseed rape. To solve the above-mentioned problems, an attempt was made to develop a precision seed drill with a roller-type-metering device and a depth control system. Some of the design parameters affecting the uniformity of seed distribution were studied from the view point of roller and brush geometry. Computer software packages were used to design the machine and simulate its operational performance. In the laboratory test, it was found that the precision seed drill performed satisfactorily and its speed and vibration did not affect the performance of metering system significantly. In the field test, a uniform distribution of seed with a reasonable spacing along the row planting was achieved and seed scattering was found to be within an acceptable range.

# Biosensors and Bioelectronics Lab.

**TITLE :** A Hybrid Robotic System for Harvesting Heavy Produce

**Author :** Yu Yong Kim, Heon Hwang, Seong In Cho

**Year :** 2008

**Abstract**

 Certain agricultural work requires a very stiff robot arm to reduce vibration and damage to products. However, the structure of conventional articulated robots tends to be too weak to manipulate heavy objects, such as melons and watermelons. The Stewart platform is a typical parallel robotic mechanism with very high stiffness, but this advantage is balanced by a small workspace and large installation space. This research proposes a new type of agricultural robot arm constructed by combining a parallel and a serial mechanism. This robot consists of a hybrid manipulator, a robot controller and an end-effector. The hybrid manipulator has serial joints with two extra degrees of freedom, making the workspace wider. It was also designed to harvest heavy fruits such as melons, even from behind obstacles such as leaves or tree branches. Position control results of the developed hybrid robot showed that it could be controlled within a $\pm1$ ㎜ and $\pm0.2°$ range of error.

### Abstract

Near-infrared spectroscopy (NIRS) is a promising technique for large-scale meat quality evaluation. Freshness, as well as meat quality, is an important parameter for consumers in purchasing this product. In this study, near-infrared (NIR) spectra in the range 950-1650 nm were used for freshness measurement of pork loin. Three parameters, volatile basic nitrogen (VBN), thiobarbituric acid (TBA), and total microbes (TM), were used as indicators to estimate the freshness. Fifty loin muscle samples from ten independent batches were stored at $5℃ ± 1℃$. The freshness parameters and NIR spectra were measured during 18 days of storage at 4-day intervals. Pre-processing of NIR spectra was conducted before statistical analysis. Principal component regression (PCR) and partial least square regression (PLSR) were used as calibration and validation for models to predict the parameters from the near-infrared spectra. Concerning the number of variables used for model development, the PLSR models were reasonable in estimating VBN, TBA, and TM of pork. The coefficients of determination between spectra and each parameter using PLSR were 0.8212, 0.5895, and 0.7804 with standard errors of cross-validation (SECV) of 2.11, 0.13, and 0.79, respectively, for VBN, TBA, and TM.

**TITLE :** Multi-functional Automated Cultivation for House Melon
- Development of Tele-robotic System -

**Author :** D. H. Im, S. C. Kim, S. I. Cho, S. C. Chung, H. Hwang

**Year    :** 2008

**Abstract**

 In this paper, a prototype tele-operative system with a mobile base was develped in order to automate cultivation of house melon. A man-machine interactive hybrid decision-making system via tele-operative task interface was proposed to overcome limitations of computer image recognition. Identifying house melon including position data from the field image was critical to automate cultivation. And it was not simple especially when melon is covered partly by leaves and stems. The developed system was composed of 5 major models: (a) main remote monitoring and task control module, (b) wireless remote image acquisition and data transmission module, (c) three-wheel mobile base mounted with a 4 dof articulated type robot manipulator (d) exchangeable modular type end tools, and (e) melon storage module. The system was operated thorough the graphic user interface using touch screen monitor and wireless data communication among operator, computer, and machine. Once task was selected from the task control and monitoring module, the analog signal of the color image of the field was captured and transmitted to the host computer using R.F. module by wireless. A sequence of algorithms identify location and size of a melon was performed based on the local image processing. Laboratory experiment showed the developed prototype system showed the practical feasibility of automating various cultivating tasks of house melon.

**TITLE :** Order-picking Algorithm for Optimizing Operation Path of Orchard Speed Sprayer

**Author :** S. Park, K. Y. Hwang, S. I. Cho

**Year :** 2008

**Journal :** Journal of Biosystems Engineering

**Abstract**

 The purpose of this study was to develop an optimal path planning program for autonomous speed sprayer in orchard. A digital map which contained coordinate information including height, width, radius of main stem, and disease of a trees was developed to build an optimal path. The digital map, dynamic programming and order-picking algorithm were used for planning an optimal path for autonomous speed sprayer. When this algorithm applied to rectangular-shaped orchards to travel whole trees, the developed program planned the same working path and same traveling distance as those of crated by conventional method. When applied to create path for multi-selected trees, irregular-shaped orchards showed 13.9% shorter path and also rectangular-shaped orchards showed 9.1% shorter path. The developed program always planeed shorter path than the path created by conventional method despite of variation of shape of orchards.

## Abstract

This study was carried out to investigate the applicability of PVC membrane-based ion-selective electrodes for macronutrients (K, Ca, and N) by measuring of potassium, calcium, nitrate ions in hydroponic nutrient solution. The capabilities of two ion-selective membranes with varying chemical compositions for each ion were evaluated in terms of sensitivity, selectivity, and lifetime to choose sensing elements suitable for measuring typical ranges of nutrient concentrations in hydroponic solutions. The selected calcium and nitrate ion-selective membranes showed effectively sensitive responses to clacium and nitrate ions with lifeimes of 25 and 15days, respectively. The addition of a cation additive to the potassium membrane cocktail allowed sensitivity to be increased whereas its lifetime was reduced from 30 days to 10 days.

**TITLE :** Measurement of Pork Freshness from Near Infrared Spectra Analysis

**Author :** Park, Tae Jin

**Year  :** 2007

**Abstract**

 The purpose of this study is to measure pork freshness from near-infrared(NIR) spectra analysis. In this study, three of freshness indexes were selected and freshness was classified into three grades. Then freshness grade of pork was judged from NIR spectra. Many studies about each freshness index had been conducted. But it is difficult to measure freshness with only one of indexes. And there was no freshness grading system using various freshness indexes.

   Values of freshness indexes could be gained through chemical experiments. But it took about one or two days and experts were needed. Therefore efficiency was low and it had no practical use in distribution industry. NIR spectroscopy was used to solve these existing problems.

   Volatile basic nitrogen(VBN), thiobarbituric acid(TBA), and total microbes(TM) were selected as pork freshness indexes. Principal component regression(PCR) and partial least squares regression(PLSR) were used for prediction of freshness indexes' values using NIR spectra.

   Each freshness index's values were predicted from NIR spectra analysis and compared with values gained from chemical experiment. As a result, coefficient of determinant($R^2$) was 0.8335 in VBN, 0.6566 in TBA, and 0.7927 in TM. Freshness grades of pork samples were judged using predicted freshness index's values and compared with grades judged using chemical experiment. As a result, forty-two(84%) of fifty samples' grades were correct. Spoiled two samples(4%) among wrong judgments were judged to eatable grade. These wrong judgments have a problem with safety. If accuracy becomes higher, this system will be put to
practical use.

**TITLE :** Development of a Portable Pork Freshness Sensor Based on Near-Infrared
Characteristics

**Author :** Seo, Hyeong Seok

**Year :** 2007

**Abstract**

Ways of measuring meat freshness are normally known as chemical methods such as bacterial population counting, spoilage of proteins, and rancidity of fats. However, those are time consuming: procedures are complicate, needs professional technique, errors occur by individual handling and not appropriate for on-site measurement. Therefore, a new sensing method which is fast, comfortable, non-destructive is needed. In this study, pork which is one of the most consumed meat in Korea is a target to develop portable freshness measuring sensor. It is based on near-infrared analysis which is fast, on-site usable, comfortable, and non-destructive.

Spoilage of meat is induced from enzyme produced by microorganism metabolism and from various gases generated by protein and fat degradation. To determine freshness indexes of pork, storage test was accomplished with pork loin. Total microbes(TM), volatile basic nitrogen(VBN) which is a indicator of protein spoilage, thiobarbituric acid(TBA) which is a indicator of fat rancidity, were selected for major indexes highly related with the pork freshness.

To develop predicting models on the pork freshness, a NIR measurement system was composed and reflectance spectra of 120 samples of pork loins were taken in region of 932-1,662nm with 5nm interval. Principal component regression(PCR) and partial least square regression(PLSR) were used for development of the pork freshness predicting models. PLSR models showed a better correlation predicting the freshness than PCR models. For predicting VBN with the PLSR models, 15 factors were used. Correlation($R^2$), standard error of calibration(SEC), standard error of prediction(SEP), correlation of validation(C.V.) of the model were 0.954, 1.066, 2.418 and 0.208, respectively. It was the most satisfied result compared to the TM and the TBA prediction results. From the results, it was feasible to decide or to measure pork freshness using the NIR characteristics.

On the revised experiment, distance between holder tip and samples was changed from 10mm to 0mm. Contact (i.e. 0mm distance) measurement had a better result. Spectra ranging 1,022-1,087nm as input variables with the PLSR model for VBN prediction showed much better correlation with $R^2$, SEC, and SEP of 0.999, 0.146 and 2.423, respectively. The high correlation at the 1,022-1,087nm range was resulted from

amine(R-NH$_2$) group absorption and the amine group is a major contributed component to VBN.

On the last step, an optimized probe holder and a portable freshness sensor was designed for a portable usage. Chemically analyzed VBN values and predicted VBN values by the developed predicting model were compared to evaluate the portable pork freshness sensor performance with unknown 40 samples. The test using reflectance spectra at 932-1,662nm range had an average error of 3.251mg%. Another test using reflectance spectra ranging from 1,022nm to 1,087nm had an average error of 3.842mg%.

From this research, major factors for the pork freshness were studied for the freshness sensor development and portable sensing was possible using NIR spectra. Specially, use of spectra ranging from 1,022nm to 1,087nm with 14 reflectance values is recommended with the respect of sensor size, shape, and portable design as a practical sensor. Detector for the sensor system requires only 14 optical diodes which matches each of 14 reflectance values and low cost on manufacturing the sensor may be possible for the on-site and portable usage.

**TITLE :** Development of Ion Selective Electrodes to Measure Ion Concentrations in Hydroponic Nutrient Solution

**Author :** Kim, Min Su

**Year** : 2007

**Abstract**

 Water culture is widely applied in Korea on our agriculture. And it is needed to diffuse and spread a circulation system for the water culture in economical and environmental aspect. In the circulation system for water culture, ion concentration control of nutrient solution is most important. We could not measure it individually by existing methods. ISEs(ion selective electrodes) were introduced, however they are not only expensive but also mainly imported. Usually farmer could not use the ISEs because of their short durability. Therefore, the improvement and localization of the sensor is highly necessary.

 We developed sensors for three inorganic ions - K, Ca, $NO_3$ - which have high portions in the nutrient solution. We measured the difference of electric potential caused by polymer membranes which react through specific ions. And in this study we selected two kinds of membrane for each ion to compare and analyze their performances. One is membrane used by commercial ion sensor and the other is membrane to be life-reinforced. If it is exposed to various ions, the membrane easily damaged. If we reinforce durability only, selectivity is decreased. Therefore, we considered the selectivity as well as the durability. And we developed a signal processor for micro current signals. We evaluated performance for individual ion solutions and nutrient solutions. And we studied on the feasibility of the sensor.

 Most of developed membrane's selectivity was good. However the calcium membrane for increasing life time had less sensitivity. The developed calcium and nitrate selective membranes have not only good sensitivity, but also good endurance. However, potassium membrane for increasing life time caused to decrease life time.

# Biomechanics & Tissue Engineering Lab.

**TITLE :** Preparation and Biocompatibility of Composite Bone Scaffolds Using Gnotobiotic Pig Bones

**Author :** A. L. Im, J. H. Chung, K. T. Lim, P. H. Choung, J. H. Hong

**Year    :** 2007

**Journal :** Journal of Biosystems Engineering

**Abstract**

 Highly porous composite bioceramic bone scaffolds were developed using sintered gnotobiotic pig bones. These scaffolds consisted of poly-D,L-lactic acid (P(D,L)LA) and bioceramic materials of pig bone powder. The bone scaffolds were able to promote biocompatibility and possess interconnected pores that would support cell adhesion and proliferation adequately. The composite scaffolds were tested with dental pulp stem cells for cytotoxicity test. Cells seeded on the composite scaffolds were readily attached, well proliferated, as confirmed by cytotoxicity test, and cell adhesion assessment. The composite bone scaffold had no toxicity in cytotoxicity test on the extract of 0.013 g scaffold to 2 ml culture medium. The cells on the composite bone scaffold proliferated better than cells on the P(D,L)LA scaffolds.

**TITLE :** Biomechanical Properties and Cytotoxicity of Chitosan Patch Scaffold for Artificial Eardrum

**Author :** J. H. Chung, J. H. Kim, Y. H. Choung, A. L. Im, K. T. Lim, J. H. Hong, P. H. Choung

**Year :** 2007

**Journal :** Journal of Biosystems Engineering

**Abstract**

 The objectives of this study were to prepare a new artificial eardrum patch using water-insoluble chitosan for healing the tympanic membrane perforations and to investigate biomechanical properties and cyotoxicity of the chitosan patch scaffold. Tensile strength and elongation at the rupture point of chitosan patch scaffolds were 2.51-73.28 MPa and 0.11-107.06%, respectively. As the biomechanical properties of chitosan patch scaffolds varied with the concentration of chitosan and glycerol, the proper conditions for the scaffold were found out. SEM analysis showed very smooth and uniform surface of chitosan patch scaffolds without pores at x1000. The result of MTT test showed that chitosan patch scaffolds had no cytotoxicity.

**TITLE :** Effect of Air-Phase Germination with Anion Radiation and Water-Spraying on Germination Ratio, Sprout Growth, and GABA Contents of Germinated Brown Rice

**Author :** K. T. Lim, J. H. Chung, J. H. Hong, J. H. Kim, E. T. Lee, A. L. Im

**Year** : 2007

**Journal :** Agricultural and Biosystems Engineering

**Abstract**

The objective of this study was to investigate the effects of air-phase germination with water-spraying and anion stimuli on germination ratio, sprout growth and $\gamma$ – aminobutyric acid (GABA) of brown rice. Air-phase germination method with intermittent spraying water improved germination ratio and sprout growth by about 100% compared with the conventional water-soaking method. Anion radiation was applied during the germination process and improved the germination ratio, sprout growth and color quality of the germinated brown rice. Germination ratio and sprout growth were improved up to 9% with anion radiation, and its brightness was higher than brown rice germinated with no anion radiation. The air-phase germination with water-spraying improved the GABA content of germinated brown rice by about 8~9 times compared with that of brown rice.

**TITLE :** Development of Water-Insoluble Chitosan Patch Scaffold to Repair Traumatic Tympanic Membrane Perforations

**Author :** Jang Ho Kim, Jun Ho Bae, Ki Taek Lim, Pill-Hoon Choung, Jung-Sub Park, Seong Jun Choi, Ae Lee Im, Eung Tae Lee, Yun-Hoon Choung, Jong Hoon Chung

### Abstract

Perforated tympanic membranes (TM) and otitis media can be managed with a paper patch or tympanoplasty. However, a paper patch is not biocompatible and tympanoplasty requires complex aseptic surgical procedures. A novel biocompatible patch with a water insoluble chitosan as the main component was prepared. Optimal mechanical characteristics of a water-insoluble chitosan patch scaffold (CPS) was $\ulcorner$ $^{\shortmid}$ lm in thickness, 7 MPa in tensile strength, and 107% in percent elongation, even though the characteristics varied significantly depending on the concentrations of chitosan and glycerol. SEM of the CPSs showed a very smooth surface as compared with that of the paper patches. These CPSs showed no cytotoxicity and had a stimulating effect on the proliferation of TM cells in in vitro study. In in vivo study, 4 (21.1%) and 17 (89.5%) TMs out of 19 adult rats with CPSs showed no perforations at 1 and 2 weeks, respectively. However, left control TMs showed healing of 0 (0%) at 1 week and 18 (94.7%) at 2 weeks. TEM findings of regenerated eardrums using CPSs showed thinner, smoother, and more compact tissues than spontaneously healed eardrums. A CPS was more effective than spontaneous healing to repair traumatic TM perforations.

**TITLE :** Effect of Low Intensity Ultrasound Stimulation on the Proliferation of
Alveolar Bone Marrow Stem Cell

**Author :** Eung Tae Lee, Ki-Taek Lim, Jang Ho Kim, Ae Lee Im, Hyun Mok Son,
Chong Su Cho, Pill-Hoon Choung, Jong Hoon Chung

**Year** : 2008

**Journal :** Tissue Engineering and Regeneration Medicine

**Abstract**

Low-intensity ultrasound stimulation produces significant multi-functional effects that are directly relevant to bone formation. It was previously found that low-intensity ultrasound stimulation enhanced bone regeneration although the exact cellular mechanism is not clear. The aim of the present study is to investigate the effect of low-intensity ultrasound stimulation on proliferation of alveolar bone marrow stem cells. Before low-intensity ultrasound stimulation, alveolar bone marrow stem cells were cultured for 24h to facilitate their attachment. The cells were cultured in medium with or without low-intensity ultrasound stimulation. The ultrasound frequency was 1 MHz. Cell cultures stimulated with ultrasound were conducted by three treatment groups - group 1: intensity(100, 200, 300, 400 and 500 mW/cm2), group 2: duty cycle(5, 10, 30 and 50%) and group 3: duration time(1, 3, 5, 10, 20 and 30 min). The effect of low-intensity ultrasound stimulation were evaluated by cell number and morphological changes. The proliferation rates of alveolar bone marrow stem cells for the particular stimulated groups were larger than those of control groups. After low-intensity ultrasound stimulation(intensity: 100 mW/cm2, duty cycle: 30% and duration time: 10 min), the alveolar bone marrow stem cell counts were significantly increased(p < 0.05). This study suggested that the cell growth cou

## Abstract

Many tractor operators are suffering from noise, vibration and dust during farm operations. The safety cab of tractor has reduced the noise and dust but not vibration. Musculoskeletal disorders and fatigue can be caused from exposure to long-term vibration. Ride vibration of tractor must be reduced not only to improve the operator's performance but also to increase the competitiveness of Korean-made tractors in the international market. This study was conducted to investigate the ride vibration levels of tractors when operated in farm works.

Ride vibrations of agricultural tractors were measured during plowing operation, rotary tillage operation, transportation on farm road and concrete road, which were primary farm works in Korea. The measurements were made when tractor operators conducted operation at their fields. They were asked to conduct the operation as usual as they did for the farm work during the measurements.

Maximum total vibration values were the highest in farm road transportation. Overall, 93.9% of tractors showed greater accelerations than the potential health risk for 8-hour specified by ISO 2631-1(1997). The higher low-frequency vibration was, the more often fatigue-decreased proficiency boundary for 8-hour specified by ISO 2631-1(1985) was exceeded. The proportion exceeding the exposure action value(EAV) within 8-hour specified by EU Directive 2002/44 was the highest in x-axis, followed by in y and z axes. The percentages of tractors exhibiting more than the upper acceptable limit of absorbed power were 7.7%, 25% during plowing operation and farm road transportation, respectively. No tractor exceeded the upper acceptable limit during rotary tillage operation and concrete road transportation.

The ride vibrations of tractors which had low engine power(below 58 ps) and were older than 3 years old were so serious that they exceeded the exposure limit for 8-hour specified by ISO 2631-1(1997). In general, however, the ride vibrations of other tractors weren't high enough to cause the health problem immediately though they exceeded mostly the potential health risk for 8-hour specified by ISO 2631-1(1997). Vibration analyses varied according to the criterion. Considering that the vibrations have a large frequency range and they are multidirectional, it's better to discuss the results on the basis of the most restrictive criterion.

**TITLE :** Evaluation of Environmental Comfort of Tractor Cabs

**Author :** Hwang, Gi Young

**Year    :** 2008

**Abstract**

Tractor operators have to work continually for long and to be directly exposed by servere weather such as server sunlight, rain, snow, and wind. Therefore operators may be under so much stress, and that may result in a drop of operation efficiency. So at this research, we evaluated environmental comfort of inside tractor cabs by measuring environmental element of inside tractor cabs such as temperature, humidity, and noise.

The temperature of inside tractor cabs was 18.3 - 36.9℃, and the average temperature was 25,2℃. The humidity of inside tractor cabs was 28.2 - 65.8%, and the average humidity was 40.3%.

As the power is higher, the average of temperature and humidity is lower. It is due to better performance of air conditioning equipment of high power tractors and larger inside of tractor cab that make air circulate more freely.

The PMV of inside tractor cabs was -1.415 - 4.273, and the average PMV was 1.19. Without using air conditioning equipment, the average PMV was 2.264 and out of comfort limits. But With using air conditioning equipment, the average PMV was -0.244 and in a comfort condition.

The sound level of inside tractor cabs was 73.5 - 89 dBA, and the average sound level was 81.5 dBA. The all of the measured tractors were satisfied with below 90 dBA, the OSHA standard.

By the ACGIH standard, the percentages of comfortable tractors are 83.3% and 75% during plowing and rotary operation, respectably.

As the power is higher, an average of sound level is lower. It is due to better quality of sound-absorbing materials and larger inside that can make thicker sound-absorbing materials.

**TITLE :** Development of a Epicycle Gear Transmission for Agricultural for Tractors

**Author :** S. H. Park

**Year   :** 2008

 **Abstract**
 Generally, the work of tractors is required variable shift level because of frequency shifting and fluctuating load. Therefore, shift operation is ought to be convenient and smooth. In order to solve this problem, the principle of an epicycle gear transmission for agricultural tractors was developed and the possibility of this transmission has being studied.

 This study was conducted to prospect the shift quality when an epicycle gear transmission is mounted. An epicycle gear transmission was modeled with software and entire model of tractor was developed for automatic transmission on supposing that the transmission was mounted in the tractor. Dynamic property of shift was simulated and a method to reduce the shift shock was considered.

# Bioenvironment System Engineering Lab.

**Author** : Y. J. Kim, J. Y. Rhee

### Abstract

In precision farming, proper calibration and operation of a variable rate machine are critical to reduce input of agrochemicals and to ensure productivity and quality of agricultural products. As an effort to introduce precision farming to rice production in Korea, a pneumatic granular applicator was developed. This investigation intended to evaluate the application performance such as application accuracy, application uniformity and to suggest how to adjust the blow-heads to get uniform application pattern, and to suggest a practical way of adjustment of the blow-heads for uniform application. Tests to evaluate the application performance were conducted. The application uniformities (CV) in both transverse direction and longitudinal direction were less than 15% and application accuracy was greater than 81%. A simple method for adjusting the inserting length of blow-heads was suggested.

**TITLE :** Performance Evaluation of Wet Scrubber for Odor Removal Using Operational Parameters

**Author :** Yang, Seung Hwan

**Year :** 2007

**Abstract**

 The consumption of livestock products has increased with economic growth in Korea, and the productivity of animal farming has increased through the technology such as intensive indoor raising. However, the environmental problem caused by livestock facilities became an obstacle preventing its continuing development. Odor is one of the pollutants from livestock facilities. Because of the fact that odor causes discomfort or disease to adjacent residents directly, claiming against installing or expanding livestock facilities has often occurred. Also, Korea Ministry of Environment promulgated 'Odor Prevention Law' in 2005. Although several techniques of odor removal have been applied in the manufacturing industry, the livestock industry has not found the appropriate technology for odor removal due to the expensive costs of installation and operation.

 Scrubbing technique can be a suitable solution for removing odor from the livestock industry. Not only it requires low installation and operating costs, but also it is effective for dust removal. Some researchers already reported that the removal efficiency of ammonia with scrubbing method was 80 ~ 90%. However, information for scrubber design or performance evaluation was not provided enough because many researches were focusing on increase of the removal efficiency.

**TITLE :** Effect of Temperature and Pressure on Depolymerization of Biomass in Wet Thermochemical Conversion Process

**Author :** Yi, Sung Dae

**Year  :** 2008

**Abstract**

Recently oil price rises sky-high and worry about global warming  caused by overuse of fossil fuel may become a reality. Most developed countries and energy enterprises concern about alternative energy and has been started investment in this area. Bio-energy has been considered as one of the environment friendly energy source.

The biomass consists of various organic compounds. Type of bio-energy, and operating condition of the reactor are related to the composition of the biomass in thermo-chemical conversion process. If specific compound has a specific operating conditions, best operating conditions could be decided by considering the compound compositions of the biomass. There are considerable amount of research on best operating condition of hydro thermochemical process of various biomass. However, research on the best condition for different organic compounds are rare.

This study has been conducted to know the effect of reaction condition to hydrocarbon depolymerization and comparison to each material and product after analysis the results from wet thermochemical conversion process of biomass produced in Korea. The results of this study can be contributed to obtain the data sheet of reaction condition according to each biomass resources. Also, it is expected that this study can be conduced to improvement of competitive power of related technology of Korea.

The materials of this study were selected as soybean oil, corn starch and soybean curd in order to achieving the accomplishment which correspond to purpose of this study. Also, the experiments were performed at different conditions such as reaction temperature and pressure using 300 cc batch type wet thermochemical conversion reactor for the same motivation and reason. Products from conversion processing experiment were compared with original materials through elemental analysis and calorific heating value analysis.

Yield rate from starch was 20 ~ 35% and soybean curd was 15 ~ 30%. The external form of product from starch was char at the end of the processing. On the other hand, the products from soybean oil and soybean curd were showed oil form as a final external form. In case of soybean oil, it was showed little difference in element ratio and heating value between before and after the reaction. Product from starch was

showed sharp increase in carbon ratio and great decrease in oxygen ratio. It showed that 36.9 MJ/kg which is the highest heating value among the results was produced and the largest difference was given at condition of 305 ℃, 100 atm. In case of soybean curd, it showed that the largest difference of carbon and oxygen ratio were produced at condition of 290 ℃, 80 atm. Specifically, it showed various heating value differences depend on various reaction condition. The highest heating value was 32.6 MJ/kg and it was obtained at condition of 305 ℃, 120 atm.

The tar-formed oil which had high viscosity value was obtained through wet thermochemical conversion processing using swine manure. This experiment was performed at condition of 305 ℃, 100 atm. and the product was analyzed. The element analysis showed that this product had 65.86% of carbon, 9.30% of hydrogen, 4.97% of nitrogen, 0.00% of sulfur and 19.87% of oxygen. Also, heating value analysis showed 16.1 MJ/kg.

**TITLE :** Study for Commercialization of a Continuous Wet Thermochemical Process System for Bio-oil Production from Swine Manure

**Author :** Lee, Sang Hun

**Year** : 2008

**Abstract**

While the Korea dependence on foreign oil is greater than before, Methods for the efficient utilization of new energy resource are emphasized today. Decreasing consumption of the fossil fuels was inevitable by the limited supply of fossil fuels and the reduction of greenhouse gas emissions. Energy conversion of the livestock manure that is hugely discharged every day can be one of them.

This thesis discusses wet thermochemical conversion that treats swine manure by environmental-friendly and produces bio-oil for energy resource. For this purpose, the 20 L-scale HTP system (Lee, 2008) was improved primarily. the quality test through the energy balance, the mass balance and the ingredient analysis with field system test was done. practical possibility is also evaluated through the economic analysis and the field adaptation.

The Improved comprehensive system was installed practical swine farm and operated continuous test. The test processes divided by inspection operation, manure transfer test, pre-treatment, pre-heating and normal operation, after-treatment were operated accurately each time. The continuous HTP system maintained 10.3±0.5 MPa of pressure and 300±2 ℃ of temperature.

Products including ASF Oil(Acetone Soluble Fraction Oil, 7.8 %wt), ANIF(Acetone Insoluble Fraction, 2.9 %wt), WSC(Water Soluble Compound, 6.7 %wt), Water(82.6 %wt) were acquired except gas product. 43.6 % of swine manure volatile solids was converted into ASF Oil.
The ASF Oil has 32.276 MJ/kg of heating value and 1.56 of H/C ratio, which is higher than coal. In element analysis, Carbon has the greatest amount (67.33 %wt). Oxygen (11.46 %wt), Nitrogen(5.18 %wt), Sulfur(0.23 %wt) were included. The viscosity of the ASF Oil was 550 cp, which is greater than gasoline, kerosene, diesel or bunker-C. In ICP analysis for heavy metal detection, it had 54.11 mg/kg Zinc. but lead and mercury that is extremely harmful for human body were not detected.
The processed water had 7.6 %wt WSC that had 16.129 MJ/kg heating value and 6.15 %wt Nitrogen. the pH of the processed water included 0.5 %wt N and 0.009 %wt S was 6.48 subacid. The environmental purification of this HTP system was estimated

good because reduction rates of BOD and COD were 52.6 % and 70.8 %, respectively. ICP analysis of PW was reported that 0.14 mg/kg phosphorus, 140.19 mg/kg potassium and 1292.22 mg/kg Calcium. this means that PW is no problem to use liquid fertilizer by SOF(2005). 0.5 %wt Nitrogen amount of PW is enough to use liquid fertilizer and applied 288 acre field per year.

The energy production rate (EPR) was analyzed with comparing produced energy amount with consumed energy amount. due to 2,516 kJ/kg of produced energy and 1,093 kJ/kg of consumed energy, The theoretical EPR was 2.30. The real EPR was 0.75 based on real energy produce recorded by the wattmeter. This means that the HTP system application is not reasonable energy efficient.

The Economic analysis of HTP system was carried out using NPV(Net Present Value) that is the difference between the present value of cash inflows and the present value of cash outflows. based on 10 years endurance operating period and 6.0 % discount rate, those were calculated Total costs including Operating expenses, Financing costs and Fixed cost and Total benefits including Usual income, Oil selling income Liquid fertilizer selling income and Carbon credit income. Sequentially, in the case of swine farm raising 500 heads, the economic profit occurs when the bio-oil price becomes more than 250 won/liter in 100,000 won, 150 won/liter in 75,000 won and 100 won/liter in 50,000 won of HTP system price per head.

This study showed that HTP system can provide the good solution of livestock manure treatment and be possible in application level. Therefore, applying this HTP technology is expected to change today's manure treatment dramatically and to increase the level of Korean new-renewable energy technology.

In order to use HTP system in livestock farms, pre-processing part of the system should be improved. Also, further researches on how to produce the HTP system in lower price, how to operate developed system with total automation, how to use the bio-oil and processed water in environment-friendly way, and how to increase additional value of the bio-oil are necessary.

**TITLE :** Basic Study on Development of Middle Scale Continuos Wet Thermochemical Conversion System for Bio-Oil Production from Swine Manure

**Author :** Lee, Min Wook

**Year    :** 2008

**Abstract**

 The consumption of livestock products has been increased with economic growth in Korea. Swine farming which was one of the most important part of livestock industry also has been developed largely. But development of scale was caused large quantities of livestock manure.

 Decreasing consumption of the fossil fuels was inevitable by the limited supply of fossil fuels and the reduction of greenhouse gas emissions. The aggressive development of new renewable energy sources is encouraged. One of new renewable energy sources was bio-energy.

 The wet thermochemical conversion system can quickly treat swine manure and product bio-oil as the source of energy. So problems of environment and energy could be solved at once.

 This study was conducted to develop the wet thermochemical conversion system to product bio-oil from swine manure. Main results of this study are as follows.

1. The wet thermochemical conversion system was divided into four part : pre-processor, high pressure supply equipment, reactor, oil- water separator.

2. Grinding of swine manure was adopted the wet grinder using the friction of the rapidly rotated disk. Swine manure was circulated to grind several times.

3. The basket strainer was used to remove alien substances but mesh screen could not stand pressure and was destroyed.

4. High pressure supply equipment was designed using the gear pump  and cylinders. Flow rates were 0.3 ~ 2 L/min at 10~15 MPa of pressure.

5. Considering the safety factor, the reactor was designed to stand 400 ℃ of temperature and 15 MPa of pressure. The dimension of reactor was 250 mm of the inner diameter, 400 mm of the height. The total capacity was 20 L.

6. Before oil-water separator, product cooled and reduced pressure. Oil product and aqueous product were separated by the difference of the specific gravity.

 After experiment with the wet thermochemical conversion system using swine manure of 40 L, the problems were caused like these.

1. Alien substances were manually removed by mesh screen.

2. The reactor could not sustain temperature when swine manure was continuously inputted.

3. The liquid was discharged into back pressure regulator during experiment.

4. When all system was installed the minimum space, it was difficult to disassemble a tube to clean.

 To solve problems caused during experiment, solutions were  proposed like these.

1. Pre-heating system must be added to increase the temperature of raw materials.

2. The design of gas-water separator must be modified to prevent the discharge of the liquid.

3. The vessel must be installed between the wet grinder and the cylinder to clean with no disassembly.

4. The continuous removal equipment of alien substances must be developed.

**TITLE :** Fertiliser Application Performance of a Variable-rate Pneumatic Granular Applicator for Rice Production

**Author :** Y. J. Kim, H. J. Kim, K. H. Ryu, J. Y. Rhee

**Year** : 2008

**Journal :** Biosystems Engineering

**Abstract**

To apply precision farming technology for rice production in Korea, a variable-rate pneumatic granule applicator with a 10m long boom span was developed. The pneumatic applicator was equipped with relatively simple blow heads and a metering system.

High accuracy, short response time, and uniform application patterns are required from a reliable fertiliser applicator for precision farming. The fertiliser application performance of the prototype applicator was tested and evaluated in the field.

The application uniformity (coefficient of variation) in both the transverse and the longitudinal direction was in the range of 11.2−-13.1% and 2.9−-15.3%, respectively. The application accuracy of the prototype was quantified as a percentile ratio of the collected fertiliser amount to the desired amount per unit area. The application accuracy ranged from 81.9% to 97.4% at its working speed range. The response time (the time delay to reach a steady application rate when the application rate is suddenly changed) ranged from 1.5 to 3.0 s. The application uniformity and the response time were sufficient compared to previous studies. The time delay of the application rate setting caused an error of 0.5−-1.0m in the travelling direction. The application accuracy was not satisfactory due to slip characteristics of the driving motor at a low application speed, but was judged to be good enough for practical use.

**TITLE :** Analysis of Determining Factors for Power Size of a Tractor

**Author :** B. G. Kim, W. O. Lee, S. Y. Shin, H. K. Kim, C. H. Kang, J. Y. Rhee

**Year    :** 2008

**Journal :** Journal of Biosystems Engineering

**Abstract**

When a farmer buys a tractor, the power size of a tractor is determined by various factors such as farm size, farmer's age, farming type, topographical area of farm. Relationships between tractor selection and these factors were found. Three regression models were developed to analyze the relationship. Those models were an OLS-1 model (based on 567 samples having tractors), an OLS-2 model, and a Tobit model (both based on the 1,941 samples).

Regression analysis results showed that farm size and farmer's age affected selection of power size for all models at an 1% significance level. It was also shown that some farming types also had significant relationships with the tractor power size. Upland cultivating farmers and livestock farmers had larger tractors than rice cultivating farmers, while orchard farmers had smaller tractors. As for the topographical area, only middle area had significant difference with plain area. Farmers who had a rice-transplanter or a combine had larger tractors than those who didn't.

# Bio Process System Lab.

**TITLE :** Small and Large Deformation Rheology for Hard Wheat Flour Dough as
Influenced by Mixing and Resting

**Author :** Yong-Ro Kim, Paul Cornillon, Osvaldo H. Campanella,
Richard L. Stroshine, Suyong Lee, Jae-Yong Shim

**Year   :** 2007

**Journal :** Journal of Food Science

**Abstract**

 The effects of mixing and resting on the physicochemical properties of doughs prepared with strong and weak hard wheat flours were investigated, specifically concerning aspects related to their rheological behavior andmolecular mobility. Small deformation dynamic tests showed that, during the initial resting period, the complex modulus G* decreased and phase angle decreased for undermixed dough, whereas overmixed dough showed opposite trends. G* values for optimally mixed dough did not vary during the resting period investigated. This was more obvious for the strong dough. Large deformation testsmore clearly showed differences among optimal, under-, and overmixed dough, and also between doughs prepared with strong and weak flour. Optimally mixed dough exhibited the highest peak stress and strain for both samples. In addition, the peak stress of dough prepared with the strong flour was higher than that of dough prepared with weak flour. Inconsistent results between small and large deformation tests implied that small and large deformation tests reflected different structural aspects of dough. NMR measurements were performed to estimate the relaxation properties of the sample upon resting. Decreased water mobility during resting, indicated by decreasing T1 relaxation time, was possibly attributed to increasing molecular interactions caused by continued hydration. Evidence of additional molecular interactions created by  mixing was also observed.

**TITLE :** Structural Characterization of Rice Starch in Rice Cake Modified by Thermus Scotoductus 4-α-glucanotransferase (TSαGTase)

**Author :** N.-S. Seo, S.-A. Roh, J.-H. Auh, J.-H. Park, Y.-R. Kim, K.-H. Park

## Abstract

Rice cake was produced with a thermostable 4-α-glucanotransferase from Thermus scotoductus (TSαGTase). Starch molecular fine structure, texture, and retrogradation for the enzymatically prepared rice cake were investigated and compared to those for control rice cake. The amylose content in TSαGTase-treated rice cakes decreased, whereas branched and linearmalto-oligosaccharides ranging frommaltose to maltoheptaose increased slightly. The average molecular weight of the enzyme-treated rice starch in rice cake decreased as amylopectin macromolecules were cleaved and reorganized into small amylopectin clusters. The number of shorter side chains (degree of polymerization [DP] < 9) increased, whereas the number of longer side chains (DP > 10) decreased through the disproportionation reaction of TSαGTase. After 24 h of storage at 4 °C, the enzyme-treated samples demonstrated significantly lower melting enthalpy of retrograded starch (0.4 mJ/mg) compared to that of the control (1.4 mJ/mg). The results indicated that TSαGTase treatment effectively inhibited starch retrogradation in rice cakes. It is suggested that the reduction of amylose content, the rearrangement of amylopectin, and the production of malto-oligosaccharides caused by TSαGTase treatment are responsible for the ineffectivemolecular reassociation of rice starch in rice cake.

**TITLE :** The action mode of Thermus aquaticus YT-1 4-α-glucanotransferase and its chimeric enzymes introduced with starch-binding domain on amylose and amylopectin

**Author :** Jin-Hee Park, Hyun-Jung Kim, Yung-Hee Kim, Hyunju Cha, Young-Wan Kim, Tae-Jip Kim, Yong-Ro Kim, Kwan-Hwa Park

**Year :** 2007

**Journal :** Carbohydrate Polymers

### Abstract

A thermostable 4-α-glucanotransferase (TAαGT) gene isolated from Thermus aquaticus YT-1 had an open reading frame of 1503 nucleotides, which encoded 500 amino acid residues for a 57,969 dalton protein. The maximum activity of the TAαGT was observed at pH 7.5 and 70℃. The enzyme catalyzed intermolecular transglycosylation of maltooligosaccharides (disproportionation) to produce linear α-1,4-glucans of various sizes. The starch-binding domains (SBD) of Bacillus stearothermophilus ET1 CGTase (E and DE) were introduced into the C-terminus of TAαGT to enhance the starch utilizing activity. The chimeric enzymes, TAαGT-E and TAαGT-DE, showed no difference in temperature optimum, transglycosylation activity, and amylolytic degradation pattern compared to TAαGT wild-type. However, TAαGT-DE exhibited the highest molar specific activity toward amylose. TAαGT-DE modified amylopectin molecules by its disproportionating activities to produce modified amylopectin clusters (Mw 105−106). Also, it demonstrated the ability to produce cyclo-amyloses with DP of 19 through 35 from amylose molecules.

**TITLE :** Freezing Behaviors of Frozen Foods Determined by 1H NMR and DSC

**Author :** Suyong Lee, Sehun Moon, Jae-Yong Shim, Yong-Ro Kim

**Abstract**

The freezing patterns of commercial frozen foods were characterized by using proton nuclear magnetic resonance (1H NMR) relaxometry and differential scanning calorimetry (DSC). The liquid-like components like unfrozen water were investigated as a function of temperature (10 to $-40℃$) and then compared with the unfrozen water content measured by DSC. The formation of ice crystals and the reduction of water in the foods during freezing were readily observed as a loss of the NMR signal intensity. The proton NMR relaxation measurement showed that the decreasing pattern of the liquid-like components varied depending on the samples even though they exhibited the same onset temperature of ice formation at around $0℃$. When compared with the unfrozen water content obtained by the DSC, the NMR and DSC results could be closely correlated at the temperature above $-20℃$. However, the distinct divergence in the values between 2 methods was observed with further decreasing temperatures probably due to the solid glass formation which was not detected by DSC.

**TITLE :** Molecular Structure of Sorghum and Waxy Sorghum Starches

**Author :** Suyong Lee, Sehun Moon, Jae-Yong Shim, Yong-Ro Kim

**Year** : 2008

**Journal :** Food Science and Biotechnology

**Abstract**

 Amylose contents and amylopectin chain architecture of sorghum and waxy sorghum starches were determined and compared with those of other common cereal and tuber starches. Also, in vitro digestibility of sorghum starch was estimated using a novel methodology. The absolute amylose content of sorghum starch was similar to that of corn and wheat starches. The side chain length distribution patterns for sorghum and waxy sorghum amylopectin were very similar to those of corn and waxy corn, respectively. The $k_{cat}/K_m$ values for sorghum and potato amylopectin did not show a significant difference. The kinetic parameters could be used as novel indicators for starch digestibility.

**TITLE :** Rheological and Gelation Properties of Rice Starch Modified with 4-α -glucanotransferase

**Author :** Kwang Yeon Lee, Yong-Ro Kim, Kwan Hwa Park, Hyeon Gyu Lee.

**Year** : 2008

**Journal :** International Journal of Biological Macromolecules

**Abstract**

 Rheological measurements were performed to characterize rice starch modified with 4-α -glucanotransferase (4αGTase) isolated from Thermus scotoductus, in terms of effects of the enzyme and starch concentration on flow behavior, gel strength, and melting and gelling kinetics of the modified rice starch. Consistency index decreased and flow behavior index increased with the level of enzyme treatment, and at high level of enzyme treatment, it demonstrated Bingham plastic behavior. As the level of enzyme decreased and the starch concentration increased, gelation time decreased and the final gel strength increased significantly. Regardless of treatment variables, all the modified starch gels melted at similar temperature.