

April 26, 2006

## **Toyobo Announces MENTALBALANCE® Fiber Products Which Induce Physical and Mental Comfort – Developed Using Proprietary Physiological and Psychological State Measurement Technology**

Toyobo has developed physiological and psychological state measurement technology which measures relaxation, sleepiness and other mental states using physiological data. What is more, Toyobo has now developed a new MENTALBALANCE® brand of fiber products utilizing this measurement technology.

The underlying research and development works were conducted under a grant from the Ministry of Economy, Trade and Industry.

### **1. Background to Developing Physiological and Psychological State Measurement Technology**

#### **(1) Development of Diverse Instrument Evaluation Sensation Measurement Technologies**

In 1982, Toyobo developed instrument measurement technologies to quantify the vague sense of “feeling hot and humid” under the catchphrase Microclimate within Clothing, and developed Microclimate within Clothing materials (yarn and fabric). Toyobo subsequently devised sensation measurement technology to evaluate various skin sensations such as hot and wet, stickiness, and clothing tightness, and used this for the product development of "Kaiteki-Science™" means comfortable science series for sportswear, underwear, bedding and shirts.

#### **(2) Development of Evaluation Methodologies from a Physiological Perspective to Support Subjective Reporting**

To date, Toyobo has mostly advanced product development based on instrument evaluation of skin sensations combined with subjective reporting (verbal reporting of perceived physiological conditions by test subjects).

There have been various problems with this approach as the subjective reporting itself sometimes becomes an obstacle and there are cases when the test subjects are infants and cannot report their sensations. Also, as time passes test subjects may lose their precision in making comparisons. So establishing an objective physiological method to back up subjective reporting had become an urgent issue.

Toyobo has now developed physiological and psychological state measurement technology which measures reactions to specific stimuli. Combining this with prior measurement technology enables high-precision multifaceted comfort evaluation.

### **2. Outline of Toyobo’s Physiological and Psychological State Measurement Technology (See Diagram)**

Toyobo's physiological and psychological state evaluation technology measures states of mind from specific physiological reactions. The physiological reactions are grasped using electrocardiogram, electroencephalogram, cerebral blood flow and other measurements.

By their nature, psychological states are complex and cannot be explained by one or two physiological reactions. However, under the technological guidance of Ritsumeikan University College of Information Science and Engineering Professor Hiroshi Hagiwara, Toyobo has examined methods of grasping psychological states using as few physiological indices as possible.

Under this approach, Toyobo conducted multivariate analysis (factor analysis) on a huge volume of accumulated data regarding the relations between subjective reports by test subjects and their physiological reactions as measured by electrocardiograms and electroencephalograms, and broadly categorized human physiological and psychological states into four quadrants defined by the two axes "level of relaxation" and "level of wakefulness," as described below. The resulting map is useful for various types of product development.

#### (1) Level of Relaxation

The measurement technology positions "relaxed" and "tense" as a psychological range along a single continuum and expresses the psychological state as a "level of relaxation." The level of relaxation can be measured using an electrocardiogram (ECG), which is often used for evaluation of autonomic nervous system activity. Specifically, the index used is the time duration between two consecutive R waves of the ECG (the RR interval) derived from frequency analysis of the RR interval.

#### (2) Level of Awake

Similarly, sleepiness and wakefulness are positioned as a psychological range along a single continuum and expressed as a "level of awake." The level of awake can be measured using an electroencephalogram, which is often used for evaluation of central nervous system activity. Specific indices used are the power spectrum ratio of the alpha waves (brain waves) when eyes are open and shut, and the power spectrum of the alpha waves when the eyes are open.

### 3. Development of the MENTALBALANCE<sup>®</sup> Fiber Products Brand

Based on the psychological and physiological map indicating the level of relaxation and the level of awake. Toyobo is now developing the MENTALBALANCE<sup>®</sup> fiber products brand which induces desirable psychological states by providing specific stimuli.

### 4. Development of the First MENTALBALANCE<sup>®</sup> Product

As the first MENTALBALANCE<sup>®</sup> product, Toyobo has taken full advantage of its unique specialty spinning technology to develop a fiber which gives a gentle, soft and warm skin contact stimulus sensation, inducing a higher level of relaxation and leading to a relaxed psychological state. This fiber features the following yarn composition to give mild contact stimulus to the skin and to buffer the slight pressure stimulus to the skin from clothing when the body moves.

A. The yarn composition minimizes the area of contact with the skin

- B. The yarn composition makes it difficult for fiber ends to strike the skin
- C. The yarn composition incorporates a lot of air
- D. The yarn and weaving composition provide low compression resistance

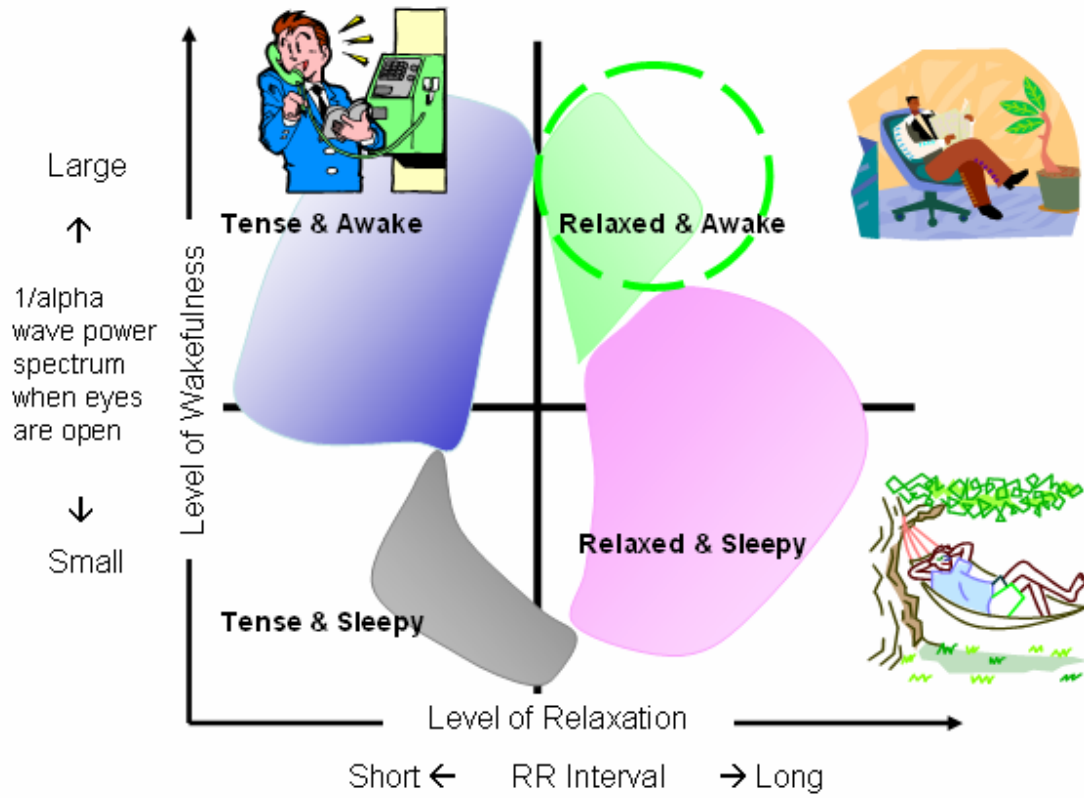
## 5. Future Developments

- (1) Toyobo is presently developing a system that can program and display on a monitor the series of measurement, calculation, analysis/judgment processes in real time to systematize physical and psychological measurement technology.
- (2) The first MENTALBALANCE<sup>®</sup> fiber products are scheduled to be sold by leading underwear manufacturers from the fall and winter of 2006.
- (3) Toyobo is engaged in the development of products inducing comfortable psychological and physiological states using various stimuli aside from the sense of touch.
- (4) Toyobo is developing MENTALBALANCE<sup>®</sup> products for various business fields aside from clothing fibers, such as sanitary supplies, interior finishing materials, and automobile-related materials.

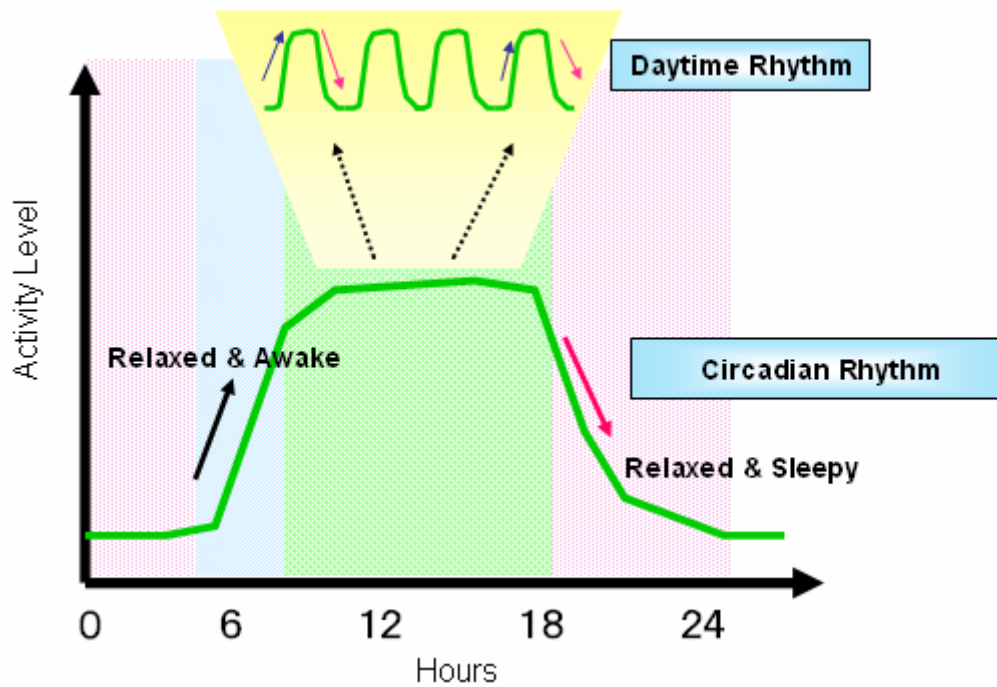
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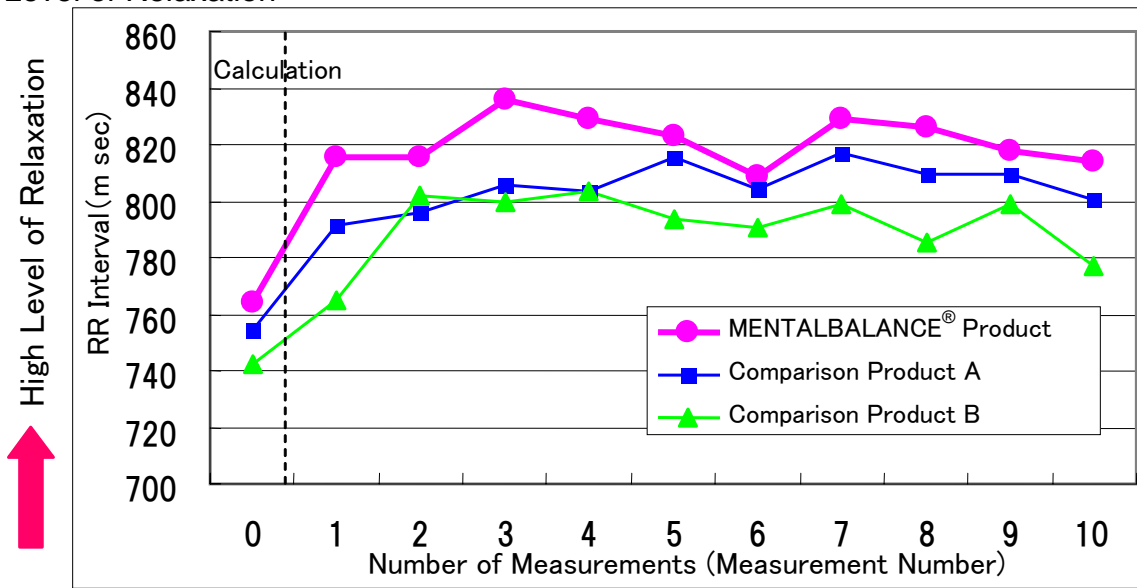
[FIGURE 1]  
Psychological and Physiological Map



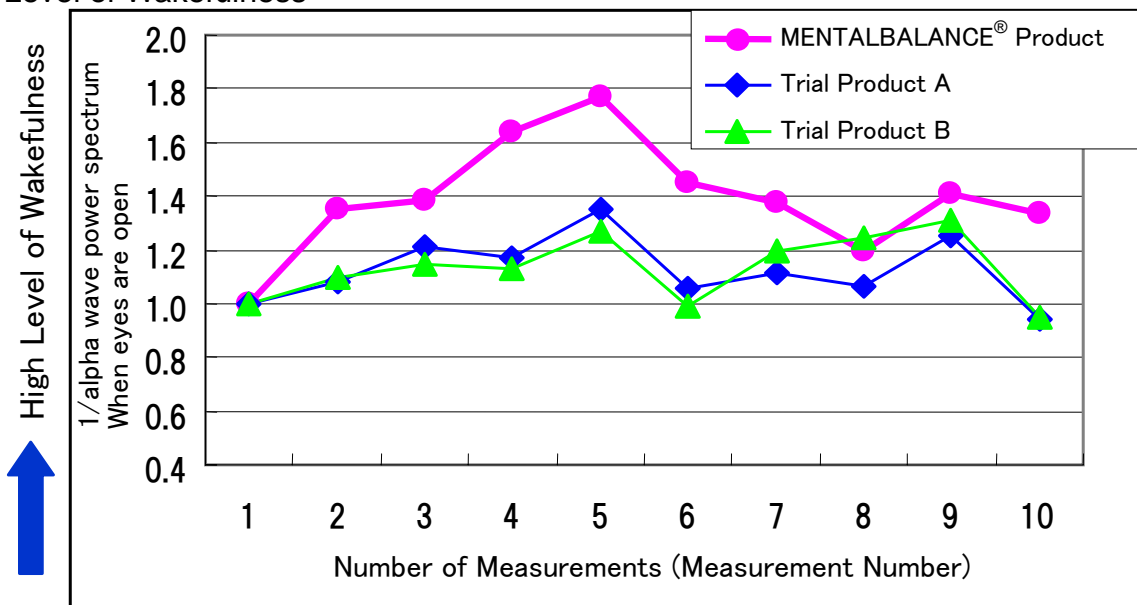
[FIGURE 2]  
Biorhythm



[FIGURE 3]  
Level of Relaxation



[FIGURE 4]  
Level of Wakefulness



## Experiment Photograph

