

Infrared imageries of human body activated by teas indicate the existence of meridian system

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Research

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Abstract

Background

Human meridian (*Jingluo*) system was hypothesized by traditional Chinese medicine (TCM) for thousands of years. In this hypothesis, there believed to be twelve formal meridian channels going through respective organs, carrying fluid and energy, and laying thermal effects. Some treatments based on meridians have been proved effective. However, existence of meridians has never been confirmed. The infrared photograph was employed to display the picture to the meridians since 1970. Unfortunately, no satisfactory results have been obtained. We think that only when a certain meridian is activated will there be thermal effect for successful infrared photograph.

Methods

We selected thirteen types of tea out of the herbs to activate the hypothesized twelve meridians for imagery taking. We collected 42 volunteers to drink teas and take infrared imageries in thirteen days. After every tea was drunk, infrared imageries of the human bodies were taken immediately. The highest temperatures of the fingers, palms, and above the organs were derived from the imageries. The averages and standard deviations of the standardized data of volunteers were calculated. Significances of the temperature difference among the body areas after drinking different teas were evaluated.

Results

We found that the temperatures of the organs and fingers possibly connected by twelve hypothesized meridians rose together significantly, i.e., the thumbs and lung after white teas, index fingers and colon after blue teas, middle fingers and thymus after dark black teas, ring fingers and gallbladder after red black teas, little fingers and heart after yellow teas. The temperature distribution on the human bodies exhibited twelve patterns following the meridian hypothesis. Infrared imageries showed quite clear shapes of the organs activated by the teas, e.g., heart and kidneys by yellow teas, thymus by dark black teas, lungs and spleen by white teas, gallbladder and thyroid by red black teas, etc. Some high temperature lines also matched the hypothetic meridians.

Conclusions

Our work displayed the imageries of the possible meridians for the first time, and proved with data that different foods may activate different organs following the meridian hypothesis, shedding light on a possible new method of targeted drug designs.

Background

Although TCM is quite different from general medicine, some special treatments of TCM were proved to be effective, such as acupuncture [1]. The theory of TCM basically depends on the hypothetic meridian system of human body. It is believed that there are twenty meridian channels going through human body,

carrying nutrition and energy. Numerous experiments have demonstrated the high electroconductivity and thermal conductivity along these channels [2, 3]. However, the anatomic structure of the meridian channels has never been revealed. There have been four major hypotheses about the structure of the meridians, i.e., autonomic nerve, body fluid channel, electromagnetic field, connective tissue interstitium [4, 5]. Not all of these hypotheses are mutually exclusive. Body fluid channel may just be in the connective tissue. When the ions flows with the fluid, it causes electrical current and raises the temperature along the meridian channel which is always felt in the human body after drinking a Chinese medicine going to a certain meridian. Recently, a fluid filled interstitial network of thick collagen bundles was found by confocal laser endomicroscopy [6], indicating that there was still unrecognized structure which might be of the TCM meridians.

To visualize the meridians and examine whether they drain along the lines suggested by TCM, many experiments have been performed. In 1970, Borsarello started to take infrared photos of meridians [7]. In the past fifty years, researchers tried many ways to take infrared imageries, e.g., acupuncture, acupressure, cooling down and rewarming the skin before taking photo, *etc.* Significant temperature difference was observed between the skin above part of the meridians and away from the meridians. However, clear photos of entire meridians have never been obtained [8]. The limitation of these experiments may due to many problems. First of all, the temperature of the skin is influenced by too many factors, among which the microcirculation under skin is definitely pronounced. Secondly, some hypothetic meridians are deep in the body, and therefore, the heat is not that easy to conduct to the skin, especially when there is thick fat in between. Most important is that only when enough ions drain through the supposed meridian will the temperature of this meridian rise. However, few experiments have provided the ions or related chemical compounds the meridian flow required when taking infrared imageries.

In TCM, all herbs were determined to go to certain meridians according to their molecular properties [9]. The twenty meridians are classified into twelve normal meridians and eight extra meridians. The compounds taken from foods can only go into normal meridians. The normal meridians go through certain organs, with which the meridians are named, such as heart meridian, liver meridian, etc. The ends of the meridians are in the hands or feet. Every hand side meridian is connected with a foot meridian and forms a meridian pair. Therefore, there are six normal meridian pairs, namely, Little Lunar (foot bottoms → kidneys → heart → little fingers), Middle Lunar (big toes → liver → thymus → middle fingers), Grand Lunar (big toes → spleen → lungs → thumbs), Little Solar (ring fingers → sanjiao/HPT axis → ears → gallbladder → little toes), Middle Solar (index fingers → large intestine/colon → nose → stomach → second toes), Grand Solar (little fingers → small intestine/duodenum → brain → urinary bladder → little toes) pairs (Fig. 1A). The previous studies did not locate the hand side meridians of Middle Lunar and Little Solar pairs to specific anatomic organs because of the ambiguities of their TCM names, heart cover meridian and three-focus meridian, while quite clear shapes of thymus covering heart and thyroid of Hypothalamus-Pituitary-Thyroid (HPT) axis [10] were observed when the corresponding meridians were activated in our experiments. According to this meridian hypothesis, the meridians in the fingers and their connections to the organs would be the easiest to observe and recognize. Moreover, the meridians are not always open for fluid draining. Twelve meridians open in turn within a day, switching every two hours.

Only when drinking the corresponding medicine will the meridian open beyond the schedule. Thus, safe medicines with strong meridian effects are essential for the experiments.

We retrieved the Chinese herbs and found that quick and clear feelings of temperature rising in different areas of human body after drinking different teas (*Camellia sinensis*) were widely reported [11]. Chinese teas are classified into six types according to six major production procedures, and are supposed to go into six meridian pairs with related medial functions, respectively. Namely, they are green teas to Grand Solar meridians, blue teas (of which oolong tea is a representative) to Middle Solar meridians, red black teas (hereafter, red teas) to Little Solar meridians, white teas to Grand Lunar meridians, dark black teas (hereafter, black teas) to Middle Lunar meridians, yellow teas to Little Lunar meridians. Teas are mostly safe for drinking. Therefore, we tested 512 kinds of tea from China, Japan, India, Sri Lanka, New Zealand, USA, and Southeast Asian countries and picked out thirteen teas with the strongest effects for twelve meridians to examine whether there were correspondences between fingers and organs in human body as suggested by meridian hypothesis.

Materials And Methods

Preparation of Volunteers

Volunteers were collected from various provinces of China for tea testing, including 17 males and 25 females. All volunteers were healthy and had no organ removals. The original imageries of the volunteers were not permitted to release for a guarantee of privacy, except for M0 as the corresponding author. Average of body mass indexes was 22.0 for males and 22.9 for females. Preliminary experiments were done on M0 to adjust the methods. Around 512 teas were tested during preliminary experiments in 2017 to select out thirteen teas with strong and different meridian effects. All volunteers were gathered to the Lvxueya White Tea Manor in Taimu Mountain, Fuding, Fujian Province for a thirteen-day experiment in July, 2018. Only one kind of tea was prepared in one day for all volunteers. During the experiment, volunteers were not allowed to eat any other medicines or condiments to avoid disturbances. Vegetables, fruits, or meats cooked without salt or other condiments were provided. Males and females were separated in different buildings for experiments.

Tea making

The selected thirteen teas (Fig. 2) belong to six types defined by famous tea scientist *Chen Chuan* in 1970s [12]. The names of tea types were defined according to the major production procedures as green tea (only inactivated by heating), blue tea (shaken then heated), red tea (piled for fermentation then heated), white tea (inactivated by sunbathing then kept sunbathing), black tea (heated then kneaded and fermented), yellow tea (heated then wrapped for fermentation). Different procedures result to different products, which make teas have different flavors and medical effects. The most famous blue tea is oolong, and therefore, most people call blue tea oolong tea by misapprehension [12]. Both red tea and black tea are called black tea outside China, or sometimes distinguished as red black tea and dark black tea. Here we still used the names defined by *Chen* to keep the nomenclature logical and systematic.

Therefore, the English black tea is called the red tea (gallbladder meridian) in this paper. Within the same type of tea, different teas exhibit different flavors and medical effects due to the genomic diversity and variations of fermentation [13, 14].

Green teas

Monkey Champion (Hou Kui) with a chrysanthemum flavor was obtained from Xieyuda Tea Co., Huangshan, Anhui province, China. It was selected to activate the Hand-Grand Solar-Duodenum meridian. Green teas with similar effect on the Gut-Brain axis [15,16] include Huangshan Maofeng, Green Snails (Biluochun), etc. Dragon Well (Long Jing) with a broad bean flavor was obtained from Hangzhou Xihu Longjing Tea Co., Hangzhou, Zhejiang province, and was selected for the Foot-Grand Solar-Bladder meridian. Similar effect was found from green teas including Black Buffalo (Wuniuzao), Turquoise Pearls (Guizhou Lyubaoshi), Dog Brain (Gounaogong), etc. Both green teas used in the experiments were newly made top grade in year 2017 (preliminary experiment) and 2018 (full experiment). Green teas were brewed in the glass pot with hot water of 75–80°C. Five gram dry tea was brewed in one liter water for ten minutes. Water was draw slowly into tea for four times in five minutes to avoid the oxidization of the polyphenols.

Blue teas

Titkuanyim with a magnolia flavor was obtained from Xuantie Tea Co., Anxi, Fujian province, China. It was selected to activate the Hand-Middle Solar-Colon meridian. Blue tea with similar effect includes the Oriental Beauty Oolong from Xinzhu, Taiwan province. Red Garment (Dahongpao, Shengjiang Grade) with a cinnamon flavor was obtained from Ruiquan Tea Co., Wuyishan, Fujian province. It was selected to activate the Foot-Middle Solar-Stomach meridian (pylorus branch). Other rock teas from Wuyishan (Bohea Mountain) also have the similar effect. Phoenix Unique (Fenghuang Dancong) with an osmanthus flavor was obtained from Gangbhudeng Tea Co., Swatow, Guangdong province. It was selected to activate the Foot-Middle Solar-Stomach meridian (cardia branch). All the blue teas used in our experiments were newly made top grade in year 2017 and 2018. Blue teas were brewed in covered porcelain bowl with hot water of 90–95°C. Five gram dry tea was brewed in 300 ml water for two minutes. After the tea soup was poured out and drunk, 300 ml hot water was drawn into the tea for two more times for drinking.

Red teas

Lapsang Souchong (Zhengshan Xiaozhong) with a chocolate flavor was obtained from Zhengshantang Tea Co., Wuyishan, Fujian province. It was selected to activate the Hand-Little Solar-HPT meridian, specifically the thyroid. Similar effect was found from Tanyang Gongfu, Luoyue Red, Keemun, etc. Those red teas with a longan flavor might activate the pituitary; however, pituitary is too deep in the head to examine in our experiments. Yunnan Red Grape (Pu Hong) with a grape flavor was obtained from Chamasi Tea Co., Jinggu, Yunnan. It was made of buds of old Pu'erh tea tree and was selected to activate the Foot-Little Solar-Gallbladder meridian. Other red teas with similar effect include Ceylon Tea,

Dianhong, Meitan Red, etc. Both red teas used in our experiments were of top grade made in year 2016. The red tea of the third year is most effective and tasty. Red teas were brewed in black pottery with hot water of 95–100°C. Five gram dry tea was brewed in 300 ml water for five minutes for three times.

White teas

Silver White Needles (Baihao Yinzhen) with a pear flavor was obtained from Lvxueya Tea Co., Fuding, Fujian province. It was selected to activate the Hand-Grand Lunar-Lung meridian. Old Eyebrows (Shou Mei) with a jujube flavor was also obtained from Lvxueya Tea Co., and was selected to activate the Foot-Grand Lunar-Spleen meridian. Both white teas used in our experiments were of top grade made in 2009, because the lunar teas turn better in effect and flavor while they are stored for longer time. The white tea of the ninth year reaches a peak of quality. White teas were all boiled in metallic electric kettle and covered above 80°C for more than a half hour. Five gram dry tea was boiled in one liter water.

Black teas

Tangerine Pu'erh (Chenxiang Shupu) with a dried tangerine peel flavor was obtained from Yeguo Tea Co., Jingmaishan, Lancang, Yunnan province. It was selected to activate the Hand-Middle Lunar-Thymus meridian. Similar effect was found from Liubao Tea of Guangxi province. Golden Fungi (Jimhua, Ruyi Grade) was obtained from Ziranyun Black Tea Co., Yongzhou, Hunan province. It was selected to activate the Foot-Middle Lunar-Liver meridian. Similar effect was found from Raw Pu'erh, Tuocha, Fuzhuan, etc. Both black teas used in our experiments were of top grade made in 2012. Black teas were all steamed in glass electric kettle and the soups were leaked down for around ten minutes until the bubbles spewed out. Five gram dry tea was boiled in one liter water.

Yellow teas

Golden Buns (Fan Jin Ji) with a wolfberry flavor was obtained from Bud-Chem Tea Co., Jiangkou, Guizhou. It was selected to activate the Hand-Little Lunar-Heart meridian. Similar effect was found from Goishi Tea of Kochi, Japan with an eggplant flavor. Golden Bricks (Jim Ding) was obtained from Jimding Tea Co., Zheng'an, Guizhou. It was selected to activate the Foot-Little Lunar-Kidney meridian. Similar effect was found from the Junshan Jinzhuan of Hunan. Both yellow teas used in our experiments were of top grade. Golden Buns were made in 2017, and Golden Bricks were made in 2018. Yellow teas were all boiled in metallic electric kettle and covered above 70°C for more than a half hour. Five gram dry tea was boiled in one liter water.

The other herbs were all boiled with 40 g dry pieces in one liter water. The soups of teas and herbs were poured out into small porcelain cups and were drunk in the temperature between 50–60°C.

Imageries taking

The volunteers took off upper clothes and kept in room temperature for around 20 minutes before drinking tea to reduce the transverse conduction of heat on skin. The room temperature were kept around 26–28°C. For each tea, every individual was asked to drink three times in 30 minutes, and imagery was taken after each time of drinking (300 ml tea soup each time). The camera was Ti450PRO Thermal

Imager (Fluke Co., WA, USA). Thermal imageries were taken from both ventral and dorsal sides within two minutes after drinking each tea. The upper part of the body, including head, arms and hands, were taken in the imageries. The distance between the camera and volunteer were three meters. Different teas were drunk in different days to avoid the mutual interference.

Data preprocessing

For each tea of one individual, the imagery showing the highest temperature was chosen for analyses. Temperature data were derived from thermal images manually. For each individual, we obtained temperature data from three parts, i.e., fingers, palms and trunci, from both ventral and dorsal sides.

On the ventral sides of the truncus, we recorded the temperatures of the skin areas above the organs including thyroid, thymus, stomach, spleen, liver, gallbladder, and duodenum. On the dorsal sides, we recorded those of heart, lungs, kidneys, colon, and urinary bladder. In each area, we found out the maximum data for analyses. As there were no significant differences between the left and right hands or between the ventral and dorsal sides of hand after data standardization, the average of the four temperatures of each finger as well as each area of palm was calculated for further analyses.

Standardization and significance test

To make the temperature data from different area comparable, we conducted centralization and standardization on fingers, palms and trunci respectively. Specifically, centering were done by subtracting the mean (μ_x) of the data from each area (omitting missing values). After that, scaling was done by dividing the centered data by their standard (σ_x) deviations.

$$z(X) = \frac{x_i - \mu_x}{\sigma_x}$$

T-tests were performed to evaluate the statistically significance of temperature changes induced by different teas. Statistical null hypothesis (H_0) was the temperature unchanged. This step was performed using *t.test()* function (default parameter). All statistical analyses mentioned above were performed in R-3.5.3.

Correlation coefficient calculating

After removing missing values, we used the *cor()* function in R to calculate Pearson correlation coefficient. This function was used for the following formula:

$$r(X, Y) = \frac{E[(x_i - \mu_x)(y_i - \mu_y)]}{\sigma_x \sigma_y} = \frac{E[(x_i - \mu_x)(y_i - \mu_y)]}{\sqrt{\sum_{i=1}^n (x_i - \mu_x)^2} \sqrt{\sum_{i=1}^n (y_i - \mu_y)^2}}$$

where r represented the Pearson correlation coefficient [17, 18].

Simultaneously, the statistical significance of r was taken into calculation using *cor.test()* function with default parameter. The test statistic was based on Pearson's product moment correlation coefficient and followed a t distribution with $\text{length}(X)-2$ degrees of freedom [19]. Statistical null hypothesis (H_0) was true correlation equal to 0. Alternative hypothesis (H_1) was true correlation not equal to 0.

Figures generation

To visually demonstrate the temperature ranges, we generated boxplot (Fig. 3, Supplementary Figs. 1, 2) and radar chart (Supplementary Fig. 3). They both exhibited the distribution of scaled temperature among three areas. The horizontal line inside the box represented the median of scaled temperature while the point of radar chart represented the mean temperature. Also the outlier dots were kept in the boxplot.

Boxplot demonstrated the temperature ranges among three areas. The x-axis showed the sampling site inside each area, i.e., five fingers inside finger area. The y-axis showed the scaled temperature which was the measurement of temperature ranges. The colors indicate different kinds of tea.

Radar chart used polar coordinates rather than commonly-used cartesian coordinates, which is suitable for displaying outliers and commonality. Similarly to boxplot, the x-axis showed the sampling site inside each area, and y-axis showed the scaled temperature. The points represented the mean temperature value.

Heatmaps were used to find out the mutual relation intra-area or inter-area. Each value inside the square is the Pearson correlation coefficient which is the commonly-used measurement of the correlation level. Blue indicate the correlation coefficient less than zero, which means negative correlation. In contrast, red means positive correlation. And the value indicates correlation intensity.

All figures were generated by ggplot2 (version 3.1.0) package in R-3.5.3.

Results

We used infrared thermor to take imageries of naked upper bodies of volunteers after drinking each tea. In preliminary experiments, the body of male volunteer M0 was scanned to adjust the methods. Temperature distributions (around 27 ~ 35°C) after drinking twelve teas were obviously different on M0 (Fig. 1B, Supplementary Table 1). Noteworthy, shapes of some organs were clearly shown as the temperature rose, e.g., heart, kidney, thymus, lungs, spleen, stomach, thyroid, gallbladder. The shapes of liver, duodenum, colon, and urinary bladder were not quite clear, but hot points within the areas of these organs were found. This proved that different teas may lay effects on different organs. The correspondence between teas and organs matches the hypothesis very well. Interestingly, only the shape of the right kidney was shown in the imagery. The left kidney of volunteer M0 might be blocked by a kidney stone of 10 mm in diameter. After he drank the yellow tea going to Little Lunar kidney meridian for a month, shape of both kidneys appeared and the kidney stone disappeared confirmed by type-B ultrasonic check (Fig. 3A). The fingers were also heated clearly after drinking teas, especially those teas

corresponding to hand side meridians. The highest temperature appeared in different fingers, for example, middle fingers for black teas, thumbs for white teas, index fingers for blue teas, etc., which also matched the hypothesis. Some parts of the body were always heated. For example, lips and esophagus were heated because of touching the warm tea soups directly. Navel, armpits, shoulders, etc. always showed high temperatures because of less exposure or concentrated arteries. Some high temperature lines matched the meridian lines quite well, such as the thymus meridian line on the dorsal side. The area of the four bladder meridian lines on the center of the back was much hotter than the ventral side after drinking the green tea for bladder. However, most of the lines were not quite clearly shown, because they are thin and deep in the body. A special example of experiment showed quite clear heart meridian (Fig. 3E) after drinking an extremely old yellow tea with an age around 137 years (confirmed by radiocarbon dating), but this tea sample was not enough for all volunteers. Several herbs were also tested for meridian activity, however, weak (Fig. 3D), partial (Fig. 3B) or mixed (Fig. 3F-H) meridians were observed. These imageries of preliminary experiments suggested that the correspondence between the tea types and the temperatures of the fingers and the organs exists. Therefore, the experiments on more volunteers (17 males and 25 females) were performed.

We derived the highest temperature data from all fingers, three areas of palms, and the skin areas above the twelve organs. The data of the hands were taken from both ventral and dorsal sides. Generally, the temperatures of thumbs are higher than other fingers, and those of the little fingers are the lowest. Therefore, we standardized the data for further analyses. Average of ventral, dorsal, right, and left data of each kind of finger was used in the following analyses as there were no significant differences among the four data after standardization (Supplementary Fig. 1). For each area of the body, we compared the standardized temperatures after drinking different teas. The male samples showed a very clear correspondence between teas and the hot areas (Fig. 4) while the female samples showed much weaker signals (Supplementary Figs. 2, 3), which might due to the shielding of more subcutaneous fat of the female volunteers [20]. Among the males, different fingers reached highest temperatures after drinking different teas, e.g., thumbs after white teas, index fingers after blue teas, middle fingers after black teas, ring fingers after red teas, and little fingers after yellow and green teas. For each type of tea, we examined both hand side meridian and foot side meridian teas. Most of the hand side teas caused the highest temperatures on the corresponding fingers except for red tea and green tea of which foot side teas caused the higher temperatures. The gaps between the highest temperature and the others of each finger were mostly significant (Supplementary Table 2). This result matches the meridian hypothesis well.

To examine whether the meridian lines behind the fingers were always heated as were seen in sample M0, we derived the data of palms. Among the male samples, significant higher temperature was observed in palm center after drinking hand side black tea than most of the other teas. Significant differences were also found between hand side green tea and foot side white tea or hand side yellow tea in hypothenar area. In thenar area, no significance was found (Fig. 4B). Among the female samples, there were significant higher temperatures in ulnar side of hand after drinking red or green teas (Supplementary Fig. 2, Supplementary Table 2). This indicates a less match between observed temperature rise and the meridian hypothesis in the palm than in the fingers.

Obviously, the temperatures above different organs rose after drinking different teas among male samples, although such heating effect will sometimes be blocked by kidney stones, gall stones, splenic cyst, hepatic adipose infiltration, etc. All the temperatures above the organs increased after drinking the hypothetic corresponding teas, except for those above bladder and spleen (Fig. 4C). The highest significances were observed for data of thymus, kidney, colon, liver and duodenum following the hypothesis. No significance was found for stomach. For lung, significance was found only between hypothetic lung meridian white tea and kidney meridian yellow tea. Also the temperature above gallbladder was clearly higher after drinking the hypothetic gallbladder meridian red tea than after liver meridian black tea. Above thyroid, data of the hypothetic HPT meridian red tea was significantly high, while those of stomach meridian blue tea, thymus meridian black tea, and gallbladder meridian red tea were significantly low (Supplementary Table 2). Therefore, we concluded that different teas will activate different organs after drinking, following the meridian hypothesis.

Moreover, we would verify whether the whole meridian would be heated at the same time after drinking a certain tea. If so, the temperatures of the fingers and above the organs would be significantly correlated. We performed a correlation analysis on all the temperature data of body areas (Fig. 5). Among males, the only significant positive correlation was between index finger and colon. There was no negative correlation between the hypothetic connected finger and organ. This result meant that the temperature of a meridian did not increase in the same time after drinking a tea. A possible explanation is that as ions in a tea drain along the meridian, temperatures of different parts will increase in succession when the ions arrive at that part. In one photo, there would usually be only one part in the highest temperature, either the organ or the corresponding finger.

Interestingly, significant negative correlations appeared within areas of truncus, palm, or fingers. The strongest negative correlations were between spleen and lung, duodenum and lung, liver and colon, gallbladder and colon, thyroid and liver, heart and gallbladder, heart and duodenum, hypothenar and palm center, thumb and index finger, thumb and middle finger. This indicated the mutual exclusion among the meridians. In addition, the strongest positive correlation was between heart and lung. Duodenum, spleen, liver, and gallbladder were also strongly correlated. This might be caused by the heat conduction between adjoining organs. Similar but less strong correlations were found among females (Supplementary Fig. 4).

Discussion

In this study, we demonstrated that the connection between fingers and organs suggested by TCM hypothesis might exist, as correspondences of temperature increasing in both fingers and organs to the teas consumed were revealed. There are various compounds in teas, especially when fermented through different procedures [21]. Six types of tea contain quite different organic molecules [13, 22], namely, polyphenols, organic acids, amides, esters, saponins, flavonoids, etc. They also exhibit obvious different medical functions. For example, white teas have been used for respiratory and immune system disorders for very long history [23]. Raw Pu'erh, a typical black tea, can attenuate hypercholesterolemia [24]. Our recent experiments proved that yellow teas are effective in treating diabetes and kidney stone

(unpublished data). The different functions can be ascribed not only to the different major molecules they contain, but may also to the different meridians leading to different organs they drain into. There may be unrecognized compounds in the herbs like teas determining the meridian attributes. To find these compounds would be a charming prospect of targeted drug designs, when the detailed structure and mechanism of meridians is revealed.

Conclusion

Meridian system is the fundamental theory based on which the TCM carries out the treatment programs, such as acupuncture, herb compound, etc. The meridian system carrying the body fluid is believed by East Asians for a very long history to be the tenth body system besides the well known nine systems, and a most important and efficient system for health keeping. After fifty years ever since French scientist Borsarello tried to take infrared imageries of the mysterious meridians, we succeeded in the first step of visualization of the human meridian system.

We demonstrated that only when the corresponding medicines were consumed will the meridians be activated, and thus the heat signals were caught. We found out twelve types of teas corresponding to twelve hypothetic meridians. The infrared imageries matched the pattern of meridian after drinking the corresponding tea. Therefore, these teas are good catalysts for meridians. The chemical contents of the teas and their mechanism of activating meridians are most important for the further researches. We think this study revealed a new field of human anatomy and biophysics, as well as medicine.

Abbreviations

HPT: Hypothalamus-Pituitary-Thyroid;

TCM: traditional Chinese medicine.

Declarations

Ethics approval and consent to participate

Our research was proved by Ethic Committee of Fudan University School of Life Sciences (Approval Number: BE1945). All volunteers signed the informed consents.

Consent for publication

All authors proved the paper for publication.

Availability of data and materials

All data needed to evaluate the conclusions in the paper are present in the paper or the supplementary materials.

Competing interests

No competing interests declared.

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Authors' contributions

H.L. and W.J. designed the research; H.L., W.J., C.W., X.A., M.S., B.H., and Y.O. performed the experiments; Y.T., H.L., C.W., L.W., and J.L. analyzed the data; and H.L., W.J. and Y.T. wrote the paper.

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Figures

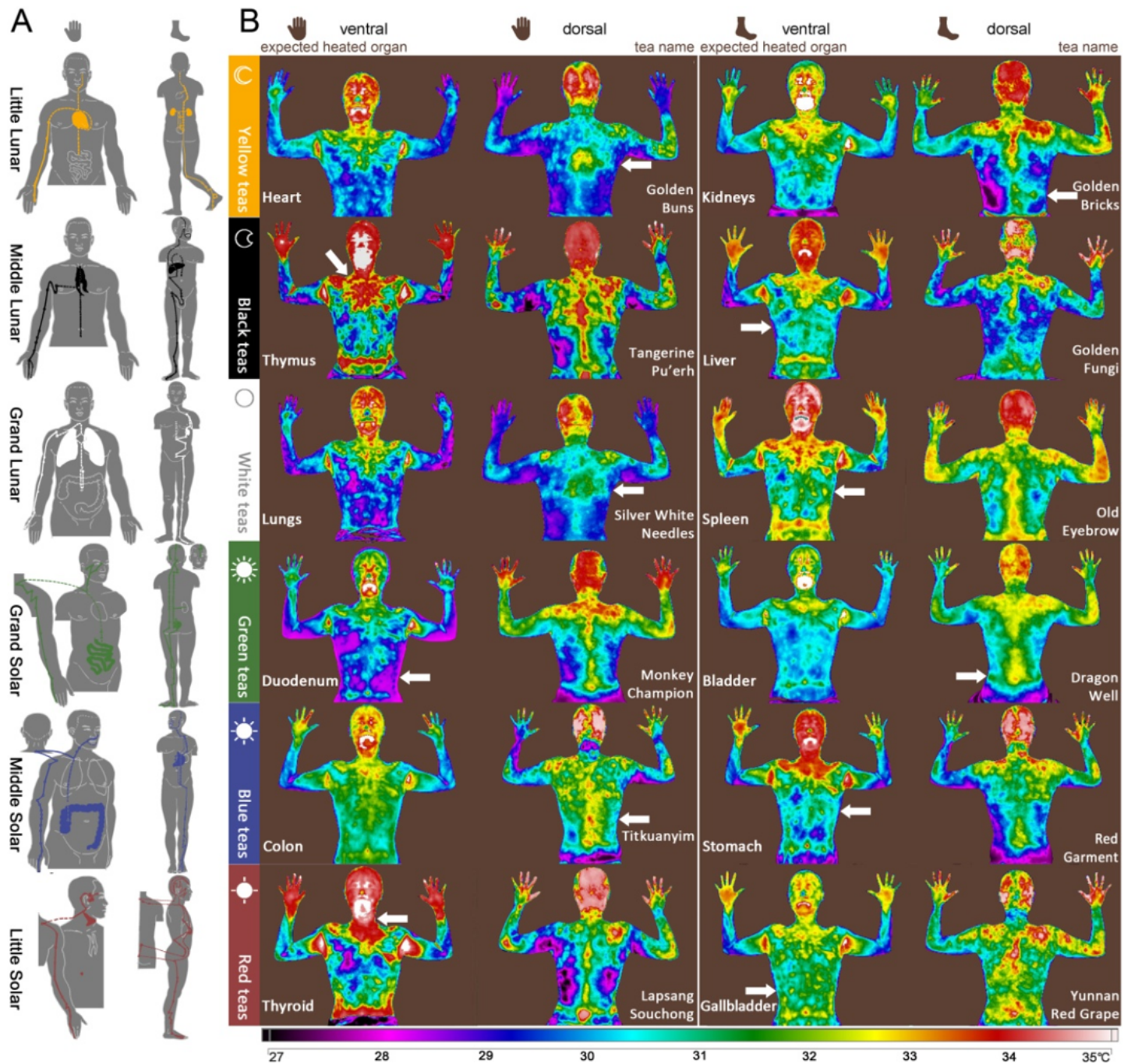


Figure 1

Infrared imageries of volunteer M0 after drinking 12 kinds of tea draining into 12 meridians of TCM. (A) Hypothetic meridian lines of TCM. Meridian lines are bilateral. Here we displayed only one side of the lines and the related organs as a demonstration. (B) Infrared imageries after drinking 12 teas. White arrows pointed to the organs with shapes or points of high temperature.



Figure 2

Thirteen teas selected for meridian experiments. Chinese names were given for easy retrieve.

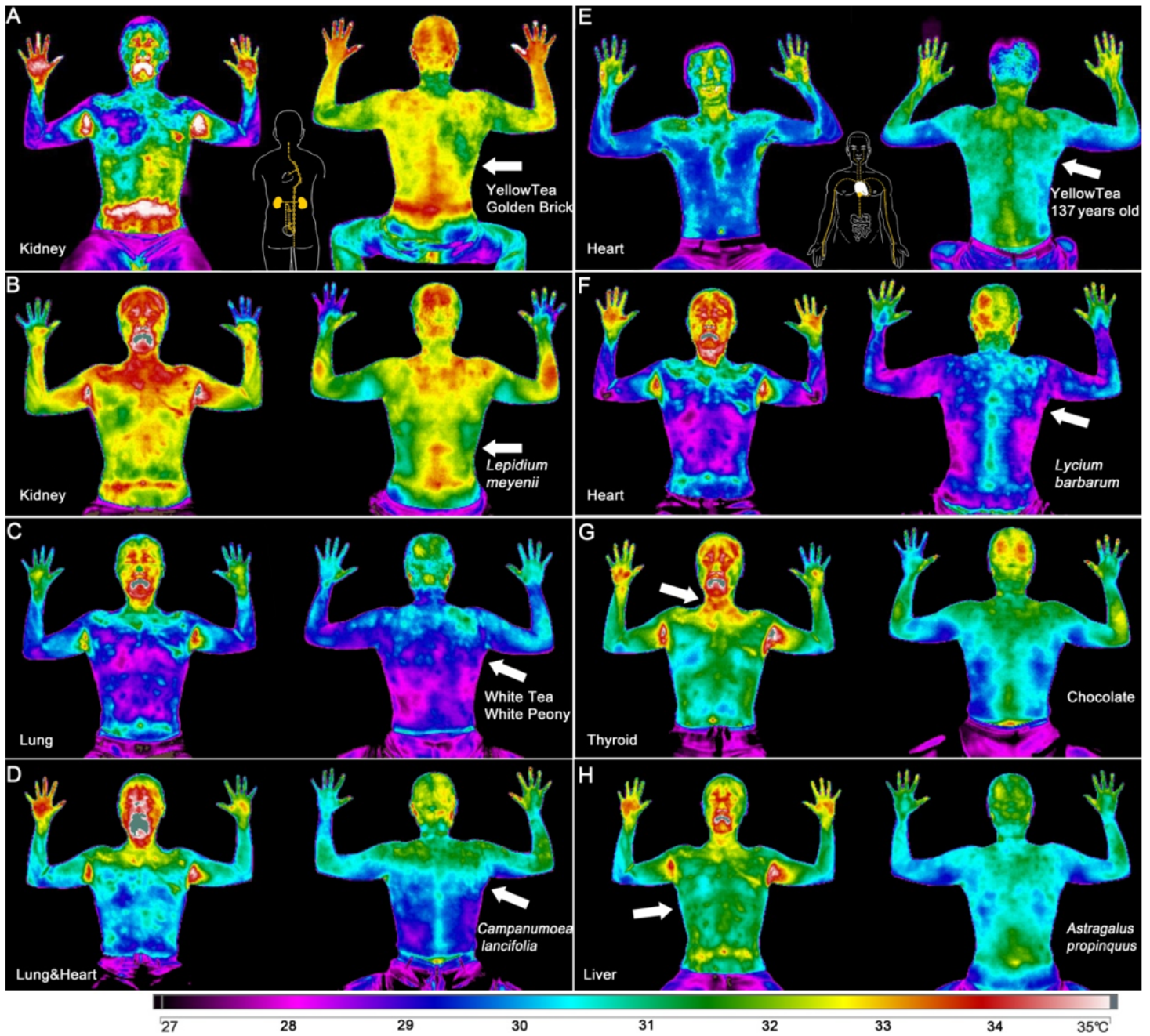


Figure 3

Infrared imageries of meridians activated by more teas and herbs. (A) The possible kidney meridian of M0 after drinking kidney yellow tea for one month. The red cross in the center of the back matches the route of the kidney meridian. The left kidney was blocked by a kidney stone for the first time drinking the kidney meridian yellow tea, Golden Bricks (Fig.1), while this imagery with both kidneys shown was taken after drinking the yellow tea every evening for one month and the kidney stone was dissolved. (B) Kidney meridian after drinking soup of *Lepidium meyenii*. Half of the kidney meridian was activated (a T-shape). (C) Lung meridian after drinking white peony tea. (D) Both shape of Lung and Heart meridians after drinking soup of *Campanumoea lancifolia*. (E) Heart meridian after drinking a 137-year-old yellow tea. A shape of question mark appeared in the center of the chest, which is the iconic shape of the heart

meridian. The broken lines extended from the heart to the little fingers as well as eyes were also clearly shown. (F) Heart meridian after drinking soup of *Lycium barbarum*. (G) Thyroid (HPT) meridian after drinking chocolate soup. (H) Liver meridian after drinking soup of *Astragalus propinquus*.

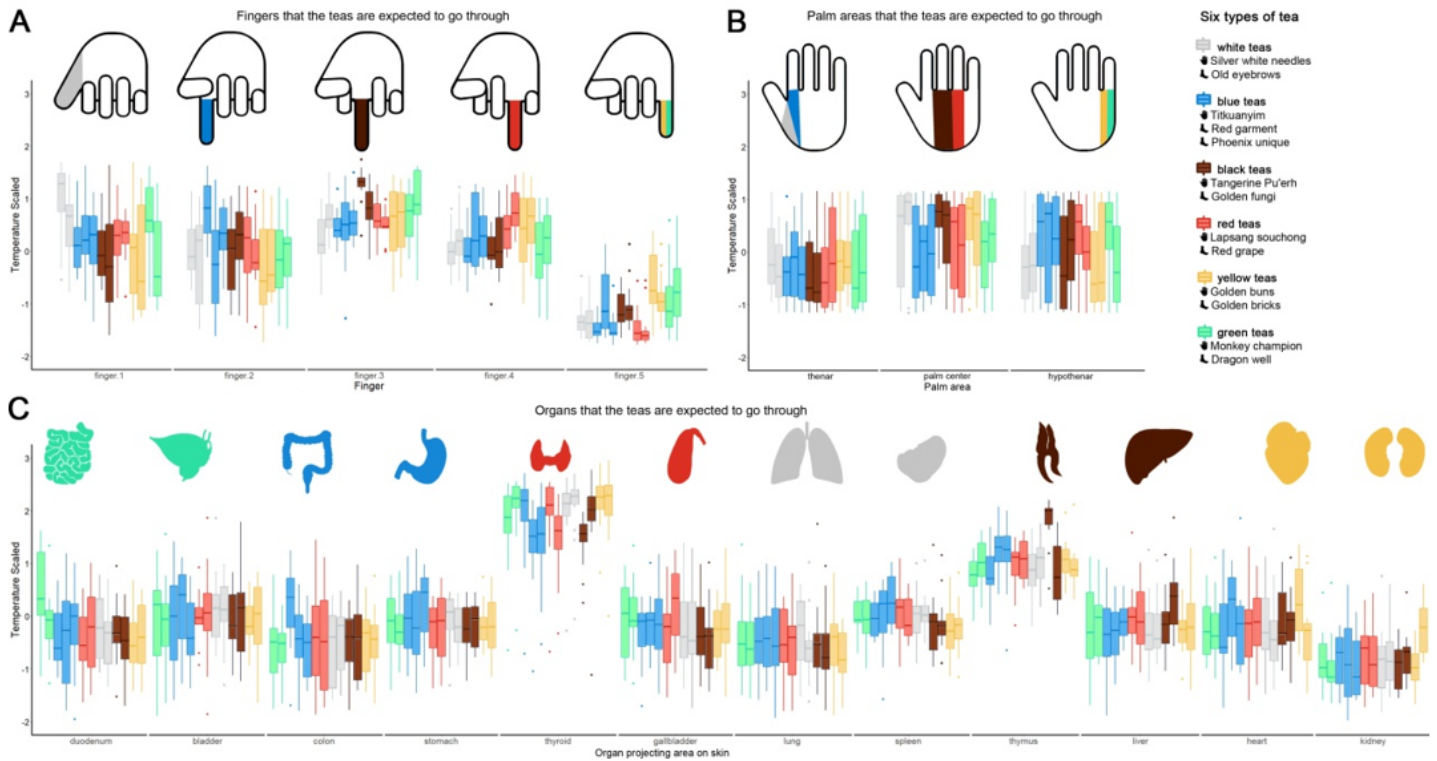


Figure 4

The standardized temperatures derived from surface areas of the body after drinking different teas. (A) The fingers. Fingers 1~5 stand for thumb, index finger, middle finger, ring finger, and little finger respectively. (B) The palm areas. (C) The skin above the organs. The bars with the same color were displayed in order of hand side tea to foot side tea from the left. Tea names were listed in the legend. Medians and 95% CI were marked on the bar. The figures above the bars indicated the areas activated by the teas distinguished with colors according to the meridian hypothesis.

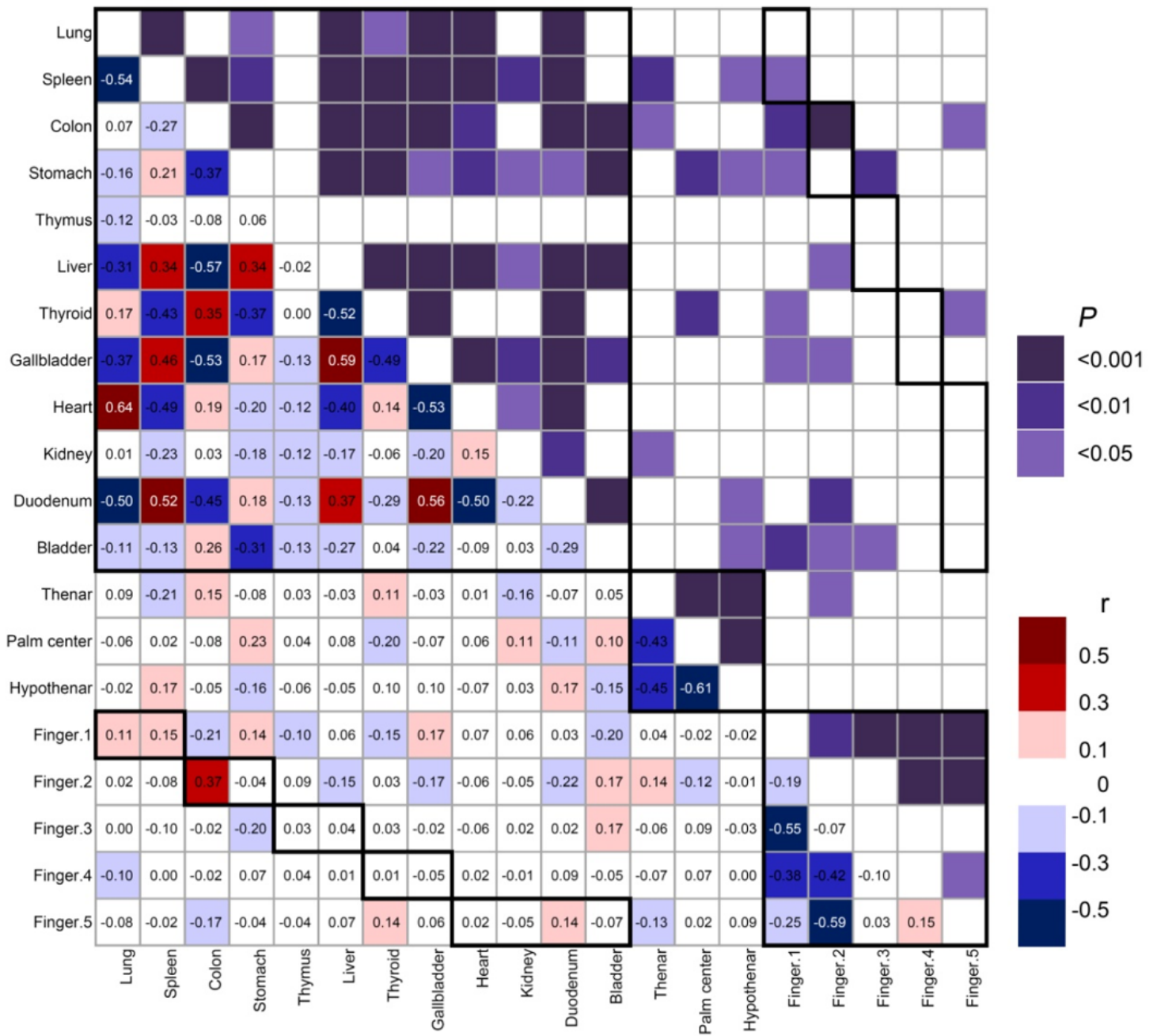


Figure 5

Correlations among temperature data of body areas after drinking teas. Significances were displayed in the right upper part. The bold boxes in the left lower part indicated the hypothetic correlations between fingers and organs. Bold boxes in the center indicated the correlations within the body parts.

Supplementary Files

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