Investigation for Using Properties of Work Wear of Food Practitioner in the Market

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Abstract. Food practitioners are the most close to food, so it is very significant to select suitable work wear during food production to ensure food safety and hygiene. Through investigation about fabric physical and chemical properties, fabric hygiene and clean properties and work clothes basic physical properties of work wear for food practitioner which are frequently seen in the market at present, this paper analyzes whether the work wear in the market have good protection properties, thus providing reference for selection of suitable work wear of food practitioner, and providing reference for food safety and hygienic management of food enterprise. Through investigation, it is found that most work wear have good moisture absorption & quick-drying property, color fastness to bleaching of hypochlorite and soil release. Moreover, the pilling, fracture and micro-particle diffusion to air will not occur easily. However, the work wear of different fabrics are different in antibacterial property, air particle filtering efficiency and electrostatic properties. The food production enterprise can equip suitable work wear according to hygiene requirements in different production processes or different produced food varieties.

1. Introduction
With constant enhancement of material living standard of people, people pay more and more attention to food safety and hygiene. The control of food safety and hygiene is crucial during food processing and production. The food processing and production personnel are the most close to food, and the scurf falling from their skin, pollutants generated by mouth, nose and ears, and the polluting components falling from shell fabric of clothes, are all hidden hazards of food pollution.

The work wear can protect production safety of people’s body, so as to prevent the foreign matter brought by human body polluting the food. The ASTM D4232-2008 Standard Performance Specification for Men's and Women's Dress and Vocational Career Apparel Fabrics[1] covers the performance requirements for woven fabrics for men’s and women’s dress and vocational career apparel. The DIN 10524-2012 Food Hygiene-Work wear in Food Business[2] proposes all-round hygienic rules for food wear, which can improve food safety and hygiene. At present, in the national standard GB14881-2013 National Standard about Food Safety - General hygiene rules for food production[3] proposes suitable requirements for management of food work wear, but there is the lack of direction meaning. Many domestic food enterprises cannot select suitable clothes. For example, some food packaging workers of delicatessen processing plants wore ordinary white gown, which is very insufficient for delicatessen processing links[4].

This paper investigates the properties of food practitioner work wear frequently seen in the market at present, analyzes whether the work wear have sufficient protection properties, thus providing reference for selection of work wear of personnel engaged in food, and providing reference for food safety and hygiene management of enterprises.
2. Investigation Contents
Considering wearing comfort of clothes and pollution easily caused by work wear during food production, this paper conducts investigation of 5 fabric physical and chemical properties, i.e. moisture absorption & quick-drying property, color fastness to bleaching of hypochlorite, pilling property, soil release, and maximum force, and 3 fabric hygiene and clean properties, i.e. antibacterial activity, air particle filtering efficiency and particle emission rate, as well as 3 work clothes basic physical properties, i.e. seam strength, color fastness and electrostatic properties.

3. Result and Analysis

3.1 Fabric Physical and Chemical Properties

3.1.1 Moisture Absorption and Quick-drying Properties
Considering that the requirements for cleanness of food practitioner work wear are relatively high, some personnel working in the clean operation region may wash their work wear for one day and even the work wear are required to be cleaned once each shift; the drying time of cleaned work wear may decide whether the work wear can be used again in time, thus influencing the quantity of work wear purchased by enterprises and input of work wear storage facilities and equipment. Compared with traditional wool or cotton clothes, the clothes with good moisture absorption and quick-drying properties may volatilize moisture more easily, and will be dried more quickly. In addition, the work wear with relatively good moisture absorption and quick-drying properties may make the personnel keep their skins dry and comfort even if they are sweating in the clothes[5-6]. Therefore, it is necessary to investigate the moisture absorption and quick-drying of fabrics of work wear. In the investigation, the frequently seen fabrics such as clean & cool wool, clean & cool fabric, clean & cool cotton, and poplin are selected, and then the methods mentioned in GB/T 21655.1-2008 Textiles - Evaluation of Absorption and Quick-drying - Part 1: Method for Combination Tests[7], FZ/T 01071-2008 Textiles - Test Method for Capillary Effect[8], and GB/T 12704.1-2009 Textiles - Test Method for Water-vapor Transmission of Fabrics - Part 1: Desiccant Method[9] to test the moisture absorption and quick-drying properties of clothes (including moisture absorption rate, dropping water diffusion time, wicking height, evaporation rate, and vapor transmission amount), and the testing results are shown in Table 1.

| Item                          | Cool & Clean Wool | Cool & Clean Fabric | Clean & Cool Cotton | Fine-line Work wear Wood | Dacron Twill Wool | Sweat-absorption Conductive Silk | Half Line Poplin | Poplin | Sweat-absorption Knitting Silk | Anti-static Sweat-absorption Twill Silk |
|-------------------------------|-------------------|--------------------|--------------------|--------------------------|-------------------|-------------------------------|------------------|--------|-------------------------------|---------------------------------------------|
| Moisture Absorption Rate (%) Dropping | 122               | 126               | 143               | 120                      | 69                | 115                           | 141             | 115               | 305                                      | 115                                         |
| Water Diffusion Time (s) Wicking Height (mm) | 0.7               | 1.5               | 0.8               | 0.68                     | 3.6               | 1.6                           | 0.7             | 1.8               | 1.5                                      | 2.2                                         |
| Evaporation Rate (g/h) | 0.34              | 0.5               | 0.52              | 0.25                     | 0.6               | 0.52                          | 0.52             | 0.55               | 0.25                                     | 0.44                                        |
| Vapor Transmission [g/㎡.d] | 8203              | 10208             | 8155              | 8101                     | 4025              | 893                           | 8487            | 8765               | 13204                                    | 10600                                       |

From the data in the Table 1, it can be known that except the dacron twill wool, the moisture absorption rates of the other 90% can reach 100% above. Except the sweat-absorption conductive silk, the wicking heights of the other 90% all can reach 150mm above. Except dacron twill wool and sweat-absorption conductive silk, the vapor transmission of fabrics of the other 80% all can reach 8,000g/(m²·d) above, with good vapor transmission. Generally, it is believed that the shell fabrics with dropping water diffusion time ≤5s has relatively good moisture absorption property, and the...
fabrics with evaporation rate of ≥0.18g/h has relatively good quick-drying property, and all tested shell fabrics can meet such requirement. Therefore, it can be believed that the selected work wear possess good moisture-absorption and quick-drying properties basically.

3.1.2 Color Fastness to Bleaching of Hypochlorite
During the investigation to food enterprise, most enterprises adopt chlorine-containing solvent to wash and disinfect the work wear, and during the food production and processing, the work wear may be also contaminated by chlorine-containing solvent. Therefore, this paper conducts investigation to color fastness to bleaching of hypochlorite. Refer to GB/T 7069-1997 Textiles - Tests for Color Fastness - Color Fastness to Bleaching: Hypochlorite\(^\text{[10]}\) to test the color fastness to bleaching of hypochlorite, shown in Table 2. Generally, if the result is ≥ Level 3, it is believed that it has good color fastness to bleaching of hypochlorite. In this investigation, the testing results of selected samples are all at Level 4-5, and it is believed that they all possess good color fastness to bleaching of hypochlorite.

### Table 2. Testing Results of Color Fastness to Bleaching of Hypochlorite (Level)

| Item                                         | Clean & Cool Wool 3# | Clean & Cool Fabric | Dacron | Clean & Cool Wool 8# | Anti-static Sweat-absorption Twill Silk | Sweat-absorption Twill Silk | Cool & Clean Wool 2# | Half line Poplin 1 | Half line Poplin 2 |
|-----------------------------------------------|----------------------|---------------------|--------|----------------------|----------------------------------------|----------------------------|----------------------|-------------------|-------------------|
| Color Fastness to Bleaching of Hypochlorite   | 4-5                  | 4-5                 | 4-5    | 4-5                  | 4-5                                    | 4-5                        | 4-5                  | 4-5               | 4-5               |
| (Level)                                       |                      |                     |        |                      |                                        |                            |                      |                   |                   |

3.1.3 Pilling
The working procedures of woven fabrics raw materials, spinning, weaving, pre-treatment and post-sorting all may influence the pilling property\([11-12]\). If the food practitioner work wear are pilling, there will be attached bacteria, which may cause potential risks to food safety, so the work wear shall be in clean status. Refer to GB/T 4802.2-2008 Textiles - Determination of Fabric Propensity to Surface Fuzzing and to Pilling - Part 2: Modified Martindale Method\([13]\) to test the pilling property of clothes, and the testing results are shown in Table 3. In DIN 10524-2012 Food Hygiene-Work wear in Food Business\([12]\), the requirements for pilling shall be level 3-4 at least. In this investigation, the work wear can meet this requirement basically.

### Table 3. Testing Results of Pilling

| Item   | Testing Method | Fine-line Work wear Wool | Work wear Wool | Clean & Cool Wool B | Clean & Cool Fabric | Twill Pure Cotton | Dacron | Dacron Twill Silk | Dacron Twill Wool | Conductive Silk |
|--------|----------------|--------------------------|----------------|--------------------|---------------------|-------------------|--------|------------------|------------------|-----------------|
| Pilling (Level) | After testing for 125 turns | 4-5                      | 4-5            | 4-5                | 4-5                 | 4-5               | 4-5    | 4-5               | 4-5              | 4-5             |
|         | After testing for 500 turns | 4-5                      | 4-5            | 4-5                | 4-5                 | 4-5               | 4-5    | 4-5               | 4-5              | 4-5             |
|         | After testing for 1,000 turns | 4-5                     | 4-5            | 4-5                | 4-5                 | 4-5               | 4-5    | 4-5               | 4-5              | 4-5             |
|         | After testing for 2,000 turns | 4                       | 4              | 4                  | 4                   | 4                 | 4      | 4                 | 4                | 4               |


3.1.4 Soil Release

The soil release means that the dirt of the stained clothes can be removed easily under the ruled cleaning conditions such as washing or scrubbing. The organic dirt during food processing generally includes food residue (such as fat) and colorant (such as grass or grape juice, or chili sauce), and the dirt which is the most difficult to be removed is blood, unless that the blood is removed rapidly, after being oxidized in the air, the blood will be transformed into insoluble substance. The soil release is an important index to verify clean degree of clothes. Refer to FZ/T 01118-2012 Textiles - Testing and Evaluation for Anti-soil Properties - Soil Release\(^{[14]}\) to test soil release of clothes, and the testing results are shown in Table 4. The investigation results conform to requirements for soil release in FZ/T 01118-2012 basically, i.e. the initial color difference conditions is ≤ Level 3, and after cleaning, the color difference level is Level 3-4 and above; the initial color difference condition is> Level 3, and the color difference level is Level 0.5 higher than the initial color difference or above.

| Item       | Type                  | Soil Release (Level) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
|------------|-----------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| After testing for 125 turns | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| After testing for 500 turns, and after testing for 1,000 turns | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| After testing for 2,000 turns | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |

### Table 4. Testing Results of Soil Release

| Item       | Type                  | Soil Release (Level) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
|------------|-----------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| After testing for 125 turns | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| After testing for 500 turns, and after testing for 1,000 turns | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| After testing for 2,000 turns | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |

| Item       | Type                  | Soil Release (Level) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
|------------|-----------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Initial Color Difference | 3 | 3.4 | 3 | 3 | 4 | 3.4 | 3.4 | 3 | 3 |
| Color Difference of Test Results | 4 | 4 | 4 | 4 | 4.5 | 4.5 | 4 | 4 | 4 |

| Item       | Type                  | Soil Release (Level) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
|------------|-----------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Initial Color Difference | 3.4 | 3 | 4 | 2 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| Color Difference of Test Results | 4 | 4.5 | 4.5 | 2.3 | 4.5 | 4.5 | 4.5 | 4 | 4 | 4 |

4
3.1.5 Maximum Force
The maximum force is the external force required by stretching clothes to breaking. The maximum force of work wear is related to its protection to food practitioner. Refer to GB/T 3923.1-2013 Textiles - Tensile Properties of Fabrics - Part 1: Determination of Maximum Force and Elongation at Maximum Force Using the Strip Method\(^\text{(15)}\) to test the maximum force of clothes, and the results are shown in Table 5, which basically meets the requirements about maximum force in FZ/T 80014-2012 Cleanroom Garment - General Technical Regulations\(^\text{(16)}\), i.e. ≥490N in the vertical direction and ≥390N in the zonal direction.

### Table 5. Testing Results of Maximum Force

| Item | Anti-static | Blue | Clean & Cool | Clean & Cool | Food | Food | Food | Food | Conductive | Food | Food |
|------|-------------|------|--------------|--------------|------|------|------|------|-------------|------|------|
|       | Work wear   | Food work wear | Wood-A Food work wear | Food work wear | 9#  | 8#  | 7#  | 5#  | 6#          | 4#  | 3#  |
| Maximum Force (vertical-direction)/N | 1150 | 596 | 650 | 1050 | 798 | 572 | 654 | 496 | 510 | 896 | 765 | 1200 |
| Maximum Force (zonal-direction)/N | 684 | 498 | 460 | 456 | 665 | 445 | 573 | 415 | 413 | 515 | 510 | 800 |

3.2 Fabric Hygiene and Clean Properties

3.2.1 Antibacterial Activity
The peculiar smell of clothes comes from bacteria on clothes; the bacteria decompose sweat and sebum cutaneous of human body, thus generating stink; meanwhile, the bacteria will contaminate the fiber of fabrics, and the fabric may contaminate food easily in case of contacting. The antibacterial woven product achieves the purpose of bacteria prevention through inhibiting bacterial proliferation. Refer to GB/T 20944.3-2008 Textiles - Evaluation for Antibacterial Activity - Part 3: Shake Flask Method\(^\text{(17)}\) to test the antibacterial activity of clothes, and the testing results are shown in Table 6. Comprehensively speaking, the antibacterial activity of half line poplin are the best. The antibacterial activity of clean & cool wool B and fine-line work wear wool to staphylococcus aureus and escherichia coli are 95% above, but it is not ideal to the bacterial prevention effect of Candida albicans. From this, it can be known that the work wear with different fabrics are different in bacterial inhibition properties, and the food production enterprises can equip suitable work wear to clean operation region, quasi-clean operation region and general operation region according to hygienic requirements during production process.

### Table 6. Testing Results of Antibacteria Activity

| Item | Basic Requirements | Cool & Clean | Half Line | Half Line | Anti-bacteria | Anti-bacteria | Fine Line |
|------|--------------------|--------------|-----------|-----------|---------------|---------------|-----------|
|       |                    | Wool B       | Poplin 1   | Poplin 2   | Dacron       | Dacron 2      | Work wear |
| Antibacterial Activity | Staphylococcus aureus | 95%          | >99%       | 99%        | 90%          | 79%          | 95%       |
|       | Escherichia coli    | 99%          | 99%        | 99%        | >65%         | >99%         |
|       | Candida albicans    | 26%          | 98%        | 99%        | 88%          | 80%          | 78%       |

3.2.2 Filtering Efficiency of Air Particles
The filtering efficiency of air particles is an index of dust filtering performance of clean fabric, which directly reflects the advantages and disadvantages of dust filtering performance of clean fabric\(^\text{(18)}\). The most effective method to prevent the micro-dust generated by human body from diffusing to the clean environment is to wear professional clean clothes. Refer to FZ/T 80014-2012 Cleanroom Garment - General Technical Regulations\(^\text{(16)}\) to test the filtering efficiency of air particles with diameter of 1μm of clothes, and the testing results are shown in Table 7. In the tested
18 samples, 22.2% of them can reach level I requirements (≥70%) specified in FZ/T 80014-2012, and 66.7% of them can reach Level II requirements (≥50%) mentioned in FZ/T 80014-2012, and all samples can meet Level III requirements specified in FZ/T 80014-2012. Therefore, the filtering efficiency of air particles of work wear with different fabrics are different, and the food production enterprises can equip suitable work wear to the clean operation region and quasi-clean operation region and general operation region according to hygienic requirements during production.

Table 7. Testing Results of Filtering Efficiency of Air Particles of Work Wear (Microparticle Diameter: 1μm)

| Name of Sample          | Testing Result | Name of Sample          | Testing Result |
|------------------------|----------------|------------------------|----------------|
| Sample 1 (2.5mm twill) | 71.4           | Sample 10 (5mm blind twill) | 67.3          |
| Sample 2 (5mm twill)   | 83.1           | Sample 11 (5mm blind twill) | 51.1          |
| Sample 3 (5mm twill)   | 57.6           | Sample 12 (twill)       | 44.4          |
| Sample 4 (5mm twill)   | 53.2           | Sample 13 (5mm twill)   | 44.3          |
| Sample 5 (5mm blind twill) | 47.8       | Sample 14 (5mm blind twill) | 67.4          |
| Sample 6 (5mm twill)   | 41.1           | Sample 15 (2.5mm twill)  | 46.2          |
| Sample 7 (5mm twill)   | 76.4           | Sample 16 (4.5mm twill)  | 53.4          |
| Sample 8 (5mm blind twill) | 53.1       | Sample 17 (5mm blind twill) | 49.4          |
| Sample 9 (5mm blind twill) | 89.4       | Sample 18 (5mm blind twill) | 58.8          |

3.2.3 Particle Emission Rate

According to FZ/T 80014-2012 Cleanroom Garment - General Technical Regulations[^16], the particle emission rate means that the material emits particles to the air during using. The particle emission rate of food work wear is an important index of food hygiene control. Refer to FZ/T 80014-2012 to test the particle emission rate of work wear, and the testing results are shown in Table 8. The data displays that all samples can meet Level I requirements (<2,000) in FZ/T 80014-2012, which can be believed that it will not emit particles to the air easily.

Table 8. Testing Results of Particle Emission Rate

| Name of Sample          | Testing Result | Name of Sample          | Testing Result |
|------------------------|----------------|------------------------|----------------|
| Sample 1 (2.5mm twill) | 848            | Sample 10 (5mm blind twill) | 1305          |
| Sample 2 (5mm twill)   | 586            | Sample 11 (5mm blind twill) | 875           |
| Sample 3 (5mm twill)   | 475            | Sample 12 (twill)       | 464           |
| Sample 4 (5mm twill)   | 383            | Sample 13 (5mm twill)   | 573           |
| Sample 5 (5mm blind twill) | 486       | Sample 14 (5mm blind twill) | 835           |
| Sample 6 (5mm blind twill) | 442       | Sample 15 (2.5mm blind twill) | 1241          |
| Sample 7 (5mm blind twill) | 315       | Sample 16 (4.5mm blind twill) | 398           |
| Sample 8 (5mm blind twill) | 469       | Sample 17 (5mm blind twill) | 469           |
| Sample 9 (5mm blind twill) | 880       | Sample 18 (5mm blind twill) | 1851          |

3.3 Work Clothes Basic Physical Properties

3.3.1 Seam Mightiness

The seam quality of clothes has an important function to quality of clothes products, and refer to GB/T 13773.2-2008 Textiles - Seam Tensile Properties of Fabrics and Made-up Textile Articles - Part 2: Determination of Maximum Force to Seam Rupture Using the Grab Method[^19] to test the seam mightiness of work wear, and the testing results are shown in Table 9. Except the testing sample Clean &Cool Wool-A food work wear, the testing results of the other samples all can meet the requirements of FZ/T 80014 Cleanroom Garment - General Technical Regulations (≥196N). Therefore, it can be believed that there is good seam mightiness.
3.3.2 Color Fastness
The color fastness means that the colors of textiles are influenced by various external factors during processing or using. For food work wear, the color fading degrees under the functions of washing, sweating and friction is an important index in textile detection [20]. The food work wear with poor color fastness may bring pollution when the food practitioner contact the food. Refer to GB 18401 National General Safety Technical Code for Textile Products [21] to test the water-resistant color fastness, sweat-resistant color fastness, and dry-resistant friction color fastness, and the tested batches of color fastness results are shown in Table 10. From the Table 10, it can be seen that the tested samples all meet Class-B requirements in GB 18401, i.e. all water-resistant color fastness, sweat-resistant color fastness, and dry-resistant friction color fastness are 3. It can be believed that the selected work wear possess good water-resistant color fastness, sweat-resistant color fastness, and dry-resistant color fastness.

### Table 9. Testing Results of Seam Mightiness

| Item                | Anti-static Work Wear | Cool & Clean Work Wear | Clean & Cool Fabric | Work Wear | Food Work Wear 9# | Food Work Wear 5# | Food Work Wear 6# | Food Work Wear 4# |
|---------------------|-----------------------|------------------------|---------------------|-----------|-------------------|-------------------|-------------------|-------------------|
| Seam Mightiness/N   | 315                   | 305                    | 188                 | 278       | 265               | 215               | 265               | 205               |

### Table 10. Testing Results of Color Fastness

| Item                                             | Testing Method | Anti-static Fine-line Work wear Wool | Anti-static Sweat-absorption Twill Silk | Anti-static Sweat-absorption Twill Silk 2 | Work wear Wool | Clean & Cool Wool A | Clean & Cool Fabric | Twill Pure Cotton | Dacron Drill | Dacron Twill Silk | Dacron Twill Wool |
|--------------------------------------------------|----------------|-------------------------------------|----------------------------------------|------------------------------------------|----------------|---------------------|---------------------|-------------------|-------------|-------------------|-------------------|
| Water-resistant Color Fastness (Level)            | color change   | 4.5                                  | 4                                       | 4.5                                      | 4.5           | 4.5                 | 4.5                 | 4.5               | 4.5         | 4.5               | 4.5               |
| Water-resistant Color Fastness (Level)            | color staining | 4                                    | 4.5                                    | 4                                        | 4.5           | 4                   | 4                   | 4                 | 4.5         | 4.5               | 4.5               |
| Sweat-resistance Color Fastness - Acidic (Level)  | color change   | 4.5                                  | 4                                       | 4.5                                      | 4.5           | 4.5                 | 4.5                 | 4.5               | 4.5         | 4.5               | 4.5               |
| Sweat-resistance Color Fastness - Acidic (Level)  | color staining | 4                                    | 4.5                                    | 4                                        | 4.5           | 4                   | 4                   | 4                 | 4.5         | 4.5               | 4.5               |
| Dry-resistant Friction Color Fastness (Level)     | color change   | 4.5                                  | 4                                       | 4.5                                      | 4.5           | 4.5                 | 4.5                 | 4.5               | 4.5         | 4.5               | 4.5               |
| Dry-resistant Friction Color Fastness (Level)     | color staining | 4                                    | 4.5                                    | 4                                        | 4.5           | 4                   | 4                   | 4                 | 4.5         | 4.5               | 4.5               |

3.3.3 Electrostatic Properties
A lot of food refers to powder status, and if the static electricity cannot be excluded or reduced effectively, there will be inflammable and explosive risk. At the same time, there are more and more electronic instruments during food production, so excluding the generation of static electricity will also reduce wrong operation of instrument effectively. In addition, the food work wear are to be cleaned, and the anti-static property can reduce absorption of clothes to dust, which is in favor of cleaning. Refer to GB 12014-2009 Static Protective Clothing [22] to test electrostatic properties of work wear, and the results are shown in Table 11. In the tested 10 samples, 30% of them can reach Class A requirements (<0.2μC/piece) mentioned in GB 12014-2009, and 30% of them can reach Class B requirements (0.2-0.6μC/piece) mentioned in GB 12014-2009. Therefore, it is suggested that the food production enterprises with anti-static requirements can select work wear with good anti-static property.
Table 11. Testing Results of Electrostatic Properties

| Item                  | Quantity of Electric Charge (μC/piece) |
|-----------------------|----------------------------------------|
| Food Workwear         | Anti-static Workwear                   |
| Food Made of Clean & Cool Wool-A | 0.1                                     |
| Food Made of Cool & Clean Fabric | 0.8                                     |
| Food Workwear         | Food Workwear9#                        |
|                       | 0.46                                   |
| Food Workwear7#       | 0.78                                   |
| Food Workwear5#       | 0.70                                   |
| Food Workwear9#       | 0.18                                   |
| Conductive Silk       | 0.55                                   |
| Food Workwear4#       | 0.15                                   |
| Food Workwear3#       | 0.65                                   |

4. Conclusions
The workwear of food practitioners is very significant for food safety and hygiene. Different clothes are different in properties. It is necessary for food enterprises to select suitable workwear based on particularity during food production and processing, such as food variety, cleaning degree of production region. In this paper, we test properties of food workwear, sorts and analyzes advantages and disadvantages of using of food practitioner workwear in market by combining relevant clothes standards. Through investigation, it is found that most workwear have good moisture absorption & quick-drying property, color fastness to bleaching of hypochlorite, and soil release. Furthmore, the pilling, fracture and micro-particle diffusion to air will not occur easily, and they can meet basic demands of food production enterprise. However, the workwear of different fabrics are different in antibacterial property, air particle filtering efficiency and electrostatic properties. The food production enterprise can equip suitable workwear according to their hygiene requirements in different production processes or different produced food varieties.

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References
[1] ASTM D4232-2008 Standard Performance Specification for Men’s and Women’s Dress and Vocational Career Apparel Fabrics, United States, 2008.
[2] DIN 10524-2012 Food Hygiene-Workwear in Food Business, Berlin, 2012.
[3] GB 14881-2013 National Standard about Food Safety - General Hygienic Regulation for Food Enterprises, Standards Press of China, Beijing, 2013.
[4] H. Xie, X.R. Hu, T.T. Li. et al. Quality Control of Workwear in Food Business, China Fiber Inspection, 16 (2015) , 32-35.
[5] Y.T. Liu, H.X. Zhang, R. He, et al. Preparation and Performance of Moisture Wicking Recycled Polyester Fabric, J. Textile Research, 37 (2016) , 96-100.
[6] M.Y. Liu, X. Wei, W.Z. Kai, et al. Comparison of Moisture Absorption and Quick-drying Standard of Textile, Dyeing, 22(2019), 47-52.
[7] B.J. Wang, H.N. Ren, Q.M. Wang, etc., GB/T 21655.1 Textiles – Evaluation of Absorption and Quick-drying – Part 1: Method for Combination Tests, Standards Press of China, Beijing, 2008.
[8] Y. Si, FZ/T 01071 Textiles - Test Method for Capillary Effect, Standards Press of China, Beijing, 2008.
[9] H. Zhang, GB/T 12704.1 Textiles - Test Method for Water-vapor Transmission of Fabrics - Part 1: Desiccant Method, Standards Press of China, Beijing, 2009.
[10] W.B. Lu, M. Xin, J.Z. Tong, etc., GB/T 7069 Textiles - Tests for Color Fastness -Color Fastness
to Bleaching: Hypochlorite, Standards Press of China, Beijing, 1997.
[11] H.Y. Lan. Influential Factors and Prevention of Fabrics Fuzzing and Pilling, Knitting Industries, 11 (2010), 17-19.
[12] Y.M. Xia, H.Y. Sun, Y.S. Yan, et al. Effect of Textile Parameters on Pilling Performance of Polyester/Cotton Woven Fabrics, Dyeing and Finishing Technology, 41 (2019), 17-19.
[13] S.X. Zhou, J.W. Hu, GB/T 4802.2-2008 Textiles - Determination of Fabric Propensity to Surface Fuzzing and to Pilling - Part 2: Modified Martindale Method, Standards Press of China, Beijing, 2008.
[14] Y. Si, F.F. Liu, L. Xu, FZ/T 01118 Textiles - Testing and Evaluation for Anti-soil Properties - Soil Release, Standards Press of China, Beijing, 2012.
[15] M. Liu, Y.Y. Zheng, Y. Wang, GB/T 3923.1 Textiles - Tensile Properties of Fabrics - Part 1: Determination of Maximum Force and Elongation at Maximum Force Using the Strip Method, Standards Press of China, Beijing, 2013.
[16] J.H. Huang, M. Xu, J. Xu, FZ/T 80014 Cleanroom Garment - General Technical Regulations, Standards Press of China, Beijing, 2012.
[17] H.Q. Zou, J.Q. Wang, Y.B. Wang, GB/T 20944.3 Textiles - Evaluation for Antibacterial Activity - Part 3: Shake Flask Method, Standards Press of China, Beijing, 2008.
[18] Y. Chen. Research on Filtering Efficiency of Air Particles of Clean Fabrics, Xi’an Polytechnic University, Xi’an, 2015.
[19] Y. Wang, H.N. Ren, L. An, GB/T 13773.2 Textiles - Seam Tensile Properties of Fabrics and Made-up Textile Articles – Part 2: Determination of Maximum Force to Seam Rupture Using the Grab Method, Standards Press of China, Beijing, 2008.
[20] L.N. Wu, Q. Shi, M.B. Wu, et al. Analysis of Seven “Textiles Determination” Proficiency Testing Results, Printing and Dyeing Auxiliary, 35 (2018), 58-61.
[21] Y.Y. Zheng, L. Xu, B.J. Wang, GB 18401 National General Safety Technical Code for Textile Products, Standards Press of China, Beijing, 2010.
[22] W.F. Yang, L.L. Zang, P.X. Zhang, GB 12014 Static Protective Clothing, Standards Press of China, Beijing, 2009.