Imparting flame resistance to citric acid modified cotton fabrics using DNA

Figure S1 shows the ester bond content of different CA mass fractions. It can be seen from the Fig S1 that the ester bond content on the surface of cotton fabric increases initially and then tends to stabilize. This is because when CA is used to modify cotton fabrics, TSC acts as a catalyst, three carboxyl groups in CA molecule are dehydrated to anhydride by two adjacent carboxyl groups to form cyclic anhydride with high reactivity, which further reacts with primary hydroxyl groups on cellulose macromolecule to form esters and release a carboxyl group.

**Figure S1.** Effect of CA mass fraction with ester bond content on Surface of cotton fabric
The effect of CA modification on whiteness of cotton fabrics is shown in Table S1. As we can see, the whiteness value of cotton fabric decreases gradually with the mass fraction of CA increases. When the CA is 9%, the whiteness value is the lowest, the fabric damage is more serious and become yellowing. Considering comprehensively, the mass fraction of citric acid is 8%.

**Table S1. Effect of CA modification on whiteness value of cotton fabric**

| Sample                  | Whiteness value | 1     | 2     | 3     | Average |
|-------------------------|-----------------|-------|-------|-------|---------|
| Original                | 135.1           | 135.0 | 135.2 | 135.1 |
| After modified by CA    | 1%              | 134.5 | 134.3 | 135.0 | 134.6   |
|                         | 3%              | 133.2 | 133.4 | 133.2 | 133.3   |
|                         | 5%              | 132.8 | 133.2 | 133.2 | 133.1   |
|                         | 7%              | 132.2 | 133.1 | 132.4 | 132.6   |
|                         | 8%              | 132.4 | 132.5 | 131.1 | 132     |
|                         | 9%              | 123   | 122.8 | 124.4 | 123.4   |
In this experiment, the flame retardant finishing effect of DNA was evaluated by changing the flame retardant properties of cotton fabric after soaping once (equivalent to household washing 5 times) according to AATCC standard. After washing one time according to AATCC standard, the result is shown as Table S2. It can be seen that with the increase of adsorption time, the damage length of cotton fabric decreases gradually during combustion. The cotton fabrics adsorbed by DNA for 5s were fully burned out, and the cotton fabrics adsorbed by DNA for 300s were only damaged in length of 38mm. The results show that cotton fabrics with longer adsorption time have stronger chemical bonding with DNA molecules. After washing, cotton fabrics contain residual flame retardants which have not been washed out, so that they retain certain flame retardant function.

**Table S2.** Vertical combustion properties of cotton fabrics treated with DNA after washing one time

| Adsorption time | 5s     | 10s    | 15s    | 30s    | 60s    | 180s   | 300s   |
|----------------|--------|--------|--------|--------|--------|--------|--------|
| afterglow time /s | 918.1  | 883.1  | 888.1  | 880.5  | 893.5  | 872.2  | 82.8   |
| afterflame time /s | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| damaged length /mm | 350    | 350    | 350    | 350    | 350    | 350    | 38     |

**Burning pictures**

![Burning pictures](image-url)