IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 2, February 2016.
www.ijiset.com
ISSN 2348 – 7968

# A study on machine knitted cotton fabrics: Comparison of physical properties

**Ms. Renu Singh[1] and Dr. Ritu Pandey[2]**

[1]Department of Home Science, University of Allahabad,
Allahabad, Uttar Pradesh, India

[2]Department of Textiles and Clothing, C. S. A. University of Ag. & Tech.,
Kanpur, Uttar Pradesh, India.

**Abstract:**

Textiles and apparels are one of the basic needs of human being. This requirement of mankind is fulfilled by fabric manufactured by four different methods namely weaving, knitting, interwining and interbonding. The use of last two methods is limited in human apparel industry. Weaving is performed by interlacing of yarns while knitted structure is constructed by interloping of continuous length of yarn. Popularity of knitted goods has grown tremendously within recent years because of increased versatility of techniques and growth in consumer demand for wrinkle resistance, stretchable, snug fitting garments, particularly in greatly expanding areas of sports-wear and other casual wear apparels. In the present study, effect of knit stitch on serviceability of the fabric was investigated. In order to find out more serviceable knit stitch a comparative study on physical properties of two types of machine knitted cotton fabrics viz; plain and tuck was carried out.

***Keywords*****:** *Plain stitch, tuck stitch serviceability, physical properties.*

## 1. Introduction

Knitting is the process of making cloth with a single yarn or, set of yarns moving in only one direction. Instead of two sets of yarns moving in only one direction as in weaving, the single knitting yarn is looped through itself to make a chain of stitches[1]. Hand knitting is an ancient craft with numerous advantages. It is dating back to pre-Christian times, though it was introduced into Britain in the fifteenth century and Queen Elizabeth I was known to have quantities of knitted stockings[2].

It is the youngest, most adventurous, most flexible, versatile and potentially all embracing system of producing fabrics of all possible descriptions. A unique feature of knitting process is the possibility of producing complete garment directly on the knitting machine[3].

In recent years, the machine knitted fabrics and made-ups are popular among consumers because of their richer aesthetic appearance, faster production and lower cost. Currently, Knitted textiles and apparel industry occupies approximately one third of the global textile market. Knitted fabrics are used in various ways such as for hospital wear, aesthetic wear, swimwear, upholstery, bedsheets and in furniture.

While renewed buoyancy in garment industry is helped by a sharp improvement in fabric knitting construction technology, therefore, to gain a better understanding about knitting, a comparative study was undertaken. The emphasis has been laid on introducing two knit stitches for the purpose of comparing and investigating its effect on fabric properties. Such systematic and technical information might improve prospects of marketing and sales of the knitted products on the basis of the serviceability of fabric.

## 2. Methods and materials

For the present research work cotton yarn of 30 count having ‘S’ twist was used for production of two types of the fabrics i.e. plain and tuck. Both the fabrics were knitted using weft knitting machine. Circular knitting machine having 11 gauge was used for construction of knitted structure.

Single jersey fabric was made with the help of plain knit stitch. It was produced on the knitting machine whose latch needle cylinder and sinker ring revolve through the stationary knitting cam system that together with their yarn feeders, were situated at regular intervals around the circumference of the cylinder. For tuck construction needles were fitted only half way towards clearing height to tuck height. The old loop opened the latch but remained on the latch needle spoon and does not slide off onto the needle stem. It remained as a held loop in the needle hook where it was joined by new loop, which became a tuck loop when the needle descended to knock over. The tuck stitch was also replaced throughout the sample. Thus, a tuck fabric drew downward, same as plain fabric.

For identification of more serviceable knit stitch, various physical properties of the fabrics were evaluated. The physical properties of samples were studied after conditioning it at the temperature of 27 ± 2□C and humidity 66 ± 2 percent for 24 hour. Each test was carried out for 5 samples and average value was calculated. In order to calculate cost of production fabric weight was evaluated. Stitch density, fabric thickness, moisture content and wicking ability tests were carried out for determination of comfort level provided by each fabric. Strength of

ISSN 2348 – 7968

prepared samples was measured in terms of fabric abrasion resistance and bursting strength. Crimp percent and Shrinkage property were evaluated to optimize the required maintenance. Aesthetic property of the samples was determined by Pilling propensity.

## 3. Results and discussion:

The results are discussed in relation to physical properties of yarn as well as knitted fabrics. Cost of production of prepared samples was also evaluated.

### 3.1 Physical properties of yarn:

The important characteristics of yarns which were evaluated to determine its quality were as follows:

**Table 1: Physical properties of yarn:**

| S. No | Yarn | Physical properties | | | | |
|---|---|---|---|---|---|---|
| | | Yarn count (tex system) | Twist per inch (TPI) | Yarn strength (g) | Tenacity (g/tex) | Elongation percent (%) |
| 1 | Cotton | 30 | 16 | 384 | 12.8 | 16 |

The two ply yarn was used. The count of the yarn was 30 s. Twist per inch of the yarn found to be 16 in 'S' direction. Yarn was also tested for yarn tenacity, strength and elongation. The values of yarn strength and tenacity were found to be 384 g and 12.8 g/tex respectively. The yarn was elongated about 16 percent.

### 3.2 Physical properties of fabric:

For the judgment of the most suitable fabric for different end uses, it should have certain desirable properties. Hence, testing of fabric for quality is important and essential. Therefore, for determining the best knit stitch the knitted fabrics were subjected to different tests and findings are discussed as follows:

#### 3.2.1. Comfort related properties:

**i). Stitch density:** The stitch density is expressed in terms of courses per inch and wales per inch[4]. It was observed that tuck fabric has lower stitch density among both the stitches. Maximum density of plain stitch indicates its maximum covering power.

**ii). Fabric thickness:** In textiles**,** fabric thickness is the distance between the upper and lower surface of the material, measured under a specific pressure[5]. The evidence from the table 2 shows that thickness value was lower for plain fabric as compared to tuck fabric. As thicker fabric creates warmth in the body thus tuck fabric will be more comfortable in cold weather while plain knitted fabric will better choice for summer clothing.

**Table 2: Comfort determining properties:**

| S. No. | Knit stitches | Stitch density (loops /inch$^2$) | Fabric thickness (mm) | Fabric weight (g/m$^2$) | Moisture content (%) | Wicking ability (%) |
|---|---|---|---|---|---|---|
| 1. | Plain | 504.4 | 0.86 | 168.8 | 4.35 | 125.99 |
| 2. | Tuck | 452.2 | 1.22 | 230.0 | 3.98 | 24.95 |

**iii). Fabric weight:**

Table 1 shows that average weight of plain knit fabric was 168.8 g/m$^2$. Similarly the average fabric weight of knitted fabric containing tuck stitch was 230 g/m$^2$. While comparing the weight of both the fabrics prepared from plain and tuck stitch, it was found that plain knitted fabric has minimum weight while tuck knitted fabric has maximum weight. Because of less fabric weight, the plain knitted fabric is finer and easy to put on and put off. Less fabric weight indicates that it causes less yarn consumption that will help in reducing the fabric cost.

**iv). Moisture content:** From the table 2 it can be observed that moisture content values were 4.35 %, and 3.98 % for plain, and tuck knitted fabrics respectively. It was found that according to mean values, plain construction had maximum moisture content followed by tuck fabric. Knit construction has significant effect on the moisture content of the fabric. Plain fabric shows more moisture content than tuck fabric because it has more number of loops of yarn floats on the surface than rib fabric. It results in penetration of more water molecules onto the surface of plain fabric.

**v). Wicking ability:** A simple measure of fabric wetness can truly reflect comfort sensation of wearer[5]. The results were evaluated on the basis of percentage of water absorbed by the fabric through its capillary system. It is evident from the table 2 that the wicking ability of plain fabric was maximum i.e. 125.99 % while tuck fabric had 24.95 % wicking ability. Thus for hot weather, the plain knit fabric is more comfortable.

#### 3.2.2. Durability and strength determining properties:

**i). Abrasion resistance:** While comparing respective fabrics containing two different knit stitches it was observed that between the two fabric samples, plain fabric showed lower weight loss and resulted in highest abrasion resistance followed by tuck fabric. The average weight loss

ISSN 2348 – 7968

recorded for plain and tuck fabrics was 0.32 % and 0.81 % respectively.

**ii). Bursting strength:** Bursting strength is the measure of the resistance for the fabric to the multidirectional flow of pressure. Bursting strength of cotton knitted fabric was carried out for both the fabrics in the similar directions and the obtained results were compared. It was found that plain knitted fabric showed maximum bursting strength.

**Table 3: Durability and strength determining properties:**

| S. No. | Knit stitches | Abrasion loss (%) | Bursting strength (pound) |
|---|---|---|---|
| 1. | Plain | 0.32 | 8.56 |
| 2. | Tuck | 0.81 | 8.14 |

### 3.2.3. Maintenance and Aesthetic related properties:

**i). Crimp percent:**
Crimp percent is defined as the mean difference between straightened thread length and the distance between the ends of the thread within the cloth expressed as percent[6].
Crimp percent of both fabrics has been tested. The result shows that crimp percent of the fabric containing plain knit stitch was 372.6 percent. For tuck fabric it was 333.0 percent. The reason for it may be that the crimp of the fabric may be affected by loop length and stitch density of the fabric because maximum stitch density may results in maximum knicks or higher crimp percent.

**ii). Fabric shrinkage:** Fabric shrinkage is the most common problem of knitted fabrics. For least required maintenance, fabric should have least fabric shrinkage. From the table 4, it can be observed that the average value of shrinkage percent for plain fabric was 11.84 %. Similarly for tuck fabric it was 10.38 %. It was found that plain fabric had higher tendency to shrink while tuck fabric had minimum shrinkage percent. Similar results were also found by Pandey et. al. (1999), who reported that hand knitted tuck stitch had least shrinkage followed by plain stitch.[3]

**iii). Pilling propensity:** The table 4 depicts that tuck fabric tend to slight pilling. The plain construction performs moderate pilling. The average number of pills or balls were 6 (S/4) and 3(S/5) for plain and tuck fabrics respectively. Aesthetic property of tuck fabric was found excellent as compared to plain fabric.

**Table 4: Maintenance and Aesthetic related properties**

| S. No. | Knit stitches | Crimp percent (%) | Shrinkage (%) | Pilling propensity (no. of balls) |
|---|---|---|---|---|
| 1. | Plain | 372.6 | 11.84 | 6(S/4) |
| 2. | Tuck | 333.0 | 10.38 | 3(S/5) |

### 3.3. Cost of production:

Cost of raw material required to produce one square meter cloth of both the knitted fabrics was calculated considering cost of raw material, labour, power cost and overhead expenditure. The cost of raw material to produce tuck fabric was maximum ie Rs. 27.54 while for plain construction it was approximately Rs. 23.48 per $m^2$ fabric. Results emphasizes that the plain knit construction had lowered overhead expenditure because of less yarn consumption. It also reduces power and labour consumption thus it indicates higher rate of production.

**Table 5: Cost of production:**

| S. No | Knitted fabrics | Cost of raw material (Rs./kg) | Cost of raw material to produce 1 $m^2$ fabric (Rs.) | Labour cost/ $m^2$(Rs.) | Power cost/ $m^2$(Rs.) | Total cost/ $m^2$ fabric (Rs.) |
|---|---|---|---|---|---|---|
| 1. | Plain | 150 | 3.76 | 17.29 | 2.43 | 23.48 |
| 2. | Tuck | 150 | 5.15 | 18.07 | 4.32 | 27.54 |

## 4. Conclusion:

It was mentioned earlier that in the present study an effort has been made to explore the effect of knit stitches on the performance of machine knitted cotton fabrics. For the fulfillment of this purpose, physical properties of knitted fabrics were tested. Plain knit stitch was introduced along with tuck stitch.

Low stitch density of the tuck fabric shows low covering power of the fabric. It shows higher value in fabric weight minimum value in abrasion resistance, wicking ability and moisture content that indicates fabric containing this stitch is less durable and comfortable to wear in hot weather. Results emphasize that fabric containing plain knit stitch had increased rate of abrasion resistance and crimp percent. These properties will make the fabric durable and resilient. Tendency to generate lesser pills will enhance aesthetic property of tuck fabric. Visual investigation shows that tuck stitch was the most beautiful and decorative stitch.

Plain stitch was thinner and lighter in weight which will make the fabric more comfortable and more economical. Higher moisture content and wicking ability of plain fabric will not encourage generation of static charge. Both of these properties will make it comfortable to wear specially in hot weather.

ISSN 2348 – 7968

The present investigation shows that on the basis of physical properties plain fabric was found as more serviceable fabric because it shows higher values in maximum physical properties such as wicking ability, moisture content, abrasion resistance and crimp percent. It has less fabric weight and thickness which make it easy to put on and put off. All of the above properties will make fabric more durable, comfortable and easy to care.

## 5. References:

1. **Cliffs, N. J.** Encyclopedia of Textiles, American fabrics, Prentice- Hall Inc. 1972.
2. **Collier A. M.** A handbook of textiles, I$^{st}$ ed., Pergamon Press, OXFORD, New York. 1970.
3. **Deshpande, S. D.; Laga, S. K. and Chakraborty J. N.,** Finishing of knitted goods, *Textile Trends*, Vol. 37, No.4, 1994, pp 41-43.
4. **Spencer D. J.,** Knitting Technology, 3$^{rd}$ ed., Woodhead Publishing Limited and Technomic Publishing Company Inc. Cambridge: England. 2001.
5. **Lyle, D. S.** Performance of Textiles. John Wiley and Sons Inc., New York. 1977.
6. **Angappan P. and Gopalkrishnan R.**. Textile Testing, S. S. M. Institute of textile technology: Komarapalayam. 1993.