# Achieving Multiple Levels of Functional Performance for Bed Sheet Fabrics Using Modern Spinning Techniques and Different Weaving Structures

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## *Abstract:*

Statement of the Problem :Choosing yarn spinning technique for warp or weft yarns, as well as weave structures of bed sheet fabrics, is based on personal judgment (which harms to final product functionally, aesthetically, and economically) without referring to accurate scientific and experimental standers that contribute to activating modern spinning techniques, in addition to unpredictability the effect of these techniques on different properties of produced fabrics. There are many modern spinning techniques for producing cotton yarns with different physical and mechanical specifications and properties. Therefore, these yarns must be classified according to use of bed sheet fabrics with different weave structures. Which achieves multiple levels of functional, aesthetic, and economic performance of final product. The scarcity of experimental and analytical studies evaluating bed sheet fabrics, and related physical, mechanical, and aesthetic properties associated with modern spinning techniques of warp or weft yarns, as well as different weave structures to achieve multiple levels of functional, aesthetic, and economic performance of final product.

Research Significance :Providing scientific and reference research for the best modern spinning techniques, as well as the best weave structures commensurate with the nature of use of bed sheet fabrics, which contributes to obtaining multiple levels of functional, aesthetic, and economic performance for the end user. Analysis, evaluation, and comparison among physical and mechanical properties of bed sheet fabrics produced from weft yarns using modern spinning techniques and with different weaving structures. Which contributes to increasing production, improving operating efficiency, increasing quality of final product, and reducing costs. Keeping pace with scientific and technical progress in achieving the best practical standards for using modern spinning techniques, their suitability for Egyptian cotton, and the extent of their effect on different properties of bed sheet fabrics with different weave structures to give final product advanced physical, mechanical, aesthetic, and economic properties superior to artificial fabrics.

Research Objectives :Achieving multiple levels of functional, aesthetic, and economic performance for bed sheet fabrics by using modern spinning techniques and different weave structures, which reflected in different forms of physiological comfort properties of user without affecting physical and mechanical properties of produced fabrics. Determining the best modern spinning techniques for weft yarns and the best weave structures for bed sheet fabrics to achieve excellence and uniqueness in quality and costs of final product and contributes significantly to marketing process locally and internationally. Studying the effect of changes in yarn structural factors for weft yarns according to modern spinning techniques, as well as weave structures on functional and aesthetic performance of bed sheet fabrics. Which helps to find stable and accurate scientific standards to control these factors, and to reach a specific measurement for that satisfies all consumers, as well as their purchasing capabilities, and achieve a great return to industrial establishment.

Research Hypothesis: The research hypothesizes that: the difference of weft yarn spinning techniques, and pre-spinning process for each one effect on physical and mechanical properties of produced fabrics, and thus achieve multiple levels of functional, aesthetic, and economical performance for bed sheet fabrics produced with different weave structures. Which makes superior to fabrics produced from artificial yarns.

Research Delimitations :Producing (5) samples of bed sheet fabrics with plain weave 1/1, (5) samples with twill weave 2/2, and (5) other samples with atlas 4 using (5) different weft yarns produced with modern spinning techniques to achieve multiple levels of functional, aesthetic, and economic performance of bed sheet fabrics.

Research Methodology :The research follows the analytical experimental method.

Experimental Work :Giza Cotton (86), which is long-staple Egyptian cotton, used to produce five different types of yarns Ne. 30/1 English cotton, with T.P.I 21, twist direction (Z) by using modern spinning techniques: (carded ring spinning, combed ring spinning, carded compact spinning, combed compact spinning, rotor spinning), then performed doubling and compact twisting processes (S), so that resultant yarn count be Ne. 30/2 English cotton (Z/S) with T.P.I 15. And using all as weft yarns to produce five samples of bed sheet fabrics with plain weave 1/1, five samples with twill 2/2, and five other samples with atlas 4 by using flexible rapier weaving loom, and using yarns produced by combed ring spinning technique as warp yarns.

Fabrics Testing: All laboratory tests were carried out on each of fabrics produced (raw without any finishing process) in weft direction with laboratory standard atmosphere at (temperature 20°C ±2, and relative humidity 65% ±2) according to American standard specifications: Fabric Tensile Strength (kg/5cm), Fabric Elongation (%), Fabric Stiffness (mlg/cm), Fabric wrinkle resistance (°), Fabric Thickness (mm), Fabric Air Permeability (mm3/mm2/S), Fabric Water Absorption (%), Fabric Weight (gm/m2).

Research Results :Bed sheet fabrics produced from weft yarns by carded ring spinning technique with different weave structures achieved the lowest value of fabric air permeability (mm3/mm2/S), the highest percentage of fabric water absorption (%), and the lowest degree of fabric wrinkle resistance (°). Bed sheet fabrics produced from weft yarns by carded compact spinning technique with different weave structures achieved the lowest percentage of fabric elongation in weft direction (%), the highest fabric stiffness in weft direction (mlg/cm), and the highest fabric thickness (mm). Bed sheet fabrics produced from weft yarns by combed compact spinning technique with different weave structures achieved the

 

highest fabric tensile strength in weft direction (kg/5cm), the lowest fabric thickness (mm), the highest degree of fabric wrinkle resistance (°), the highest value of fabric Air permeability (mm3/mm2/S), the lowest percentage of fabric water absorption (%), and the lowest fabric weight (gm/m2). Bed sheet fabrics produced from weft yarns by rotor spinning technique with different weave structures achieved the lowest fabric tensile strength in weft direction (kg/5cm), the highest fabric elongation percentage in weft direction (%), the lowest fabric stiffness in weft direction (mlg/cm), and the highest fabric weight (gm/m2). Laboratory tests conducted on all bed sheet fabrics (raw without any finishing processes) to show physical and mechanical differences in produced fabrics according to modern spinning techniques. The finishing processes reducing the differences in different properties of produced fabrics. The combing process played a very big role in improving functional and aesthetic properties of both cotton yarns produced by ring spinning technique, compact spinning technique, and thus both types of bed sheet fabrics. The compact twisting process played a very big role in improving functional and aesthetic properties of cotton yarns produced by modern spinning techniques, and thus increasing life span of both types of bed sheet fabrics.

## *Keywords:*

Carded Ring Spinning, Combed Ring Spinning, Carded Compact Spinning, Combed Compact Spinning, Open-End Spinning (Rotor Spinning), Bed Sheet Fabrics

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