

## Scanning Electron Microscopic Studies on Jute Fibre: Effect of Processing on Surface Structure

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Jute filaments from different stages of processing, examined under a scanning electron microscope, showed different types of damage to the fibre surface. Surface peeling, abrasion, pulling out of ultimate fibres and cracks were observed in some of the filaments from breaker and finisher cards. In some cases, development of cracks ultimately resulted in fracture. Similar types of damage were observed in some of the filaments from the subsequent stages of drawing.

**Keywords:** Fibre structure, Jute fibre, Scanning electron microscopic studies

### 1 Introduction

Jute fibres as obtained from the plant form a big mesh<sup>1</sup>. To make the fibres spinnable the mesh has to be split and broken into filaments by the processing system<sup>2</sup>.

While no work has been done on the effect of processing on fibre structure, the effect of variation of carding parameters on fibre and yarn quality has been studied by many workers. Nerurkar and Murthy<sup>3</sup> examined the effect of production rate on yarn quality. Raychaudhury and Palit<sup>4</sup>, and Chakrabarty<sup>5</sup> examined the effect of draft variation on jute yarn quality. Majumdar and Bandyopadhyay<sup>6</sup> observed that an increase in the draft and delivery rate had an opposite effect on yarn quality.

While studying cotton yarns by scanning electron microscope, Hearle<sup>7</sup> showed the details of fibres—twisting and bending—in the yarn. He also showed how a particular fibre could be spotted in a yarn and then examined in more detail. Betrabet *et al.*<sup>8</sup> examined the damage and fibrillation of surface fibres of OE-spun yarns from cotton and polyester and acrylic and viscose blend. Munshi *et al.*<sup>9</sup> examined twisting of fibres, cracks and other damages on the fibre surfaces of sewing threads. Paralikar *et al.*<sup>10</sup> observed surface peeling of polyester fibres in rotor-spun polyester yarns.

In this investigation, we have studied the effect of different stages of processing on the surface structure of fibre by the use of an SEM.

### 2 Materials and Methods

Slivers were collected from breaker card, finisher card, and first-drawing, second-drawing and third-drawing stages. Two samples were taken for SEM examination. For this, filaments were separated and individual ones were mounted on specimen holders,

Durafix being used as adhesive. The samples were coated in vacuo with a silver layer 20 nm thick. The coated samples were examined on a Hitachi S-430 SEM at accelerating potentials 15 kV and 20 kV.

### 3 Results and Discussion

Figs 1a and 2a are the electron micrographs of control jute fibres. Fig. 1a shows overlying deposits on three ultimate fibres; there are deposits and debris on the fibre surface obscuring fibrillar structure. Figs 1b, 2b and 2c, relating to fibres processed in breaker card, show that the longitudinal and transverse cracks develop on the surface, broken ends of the fibres being indicated by arrows. In a few filaments the ultimate fibres were pulled out and the filaments became thinner. The fibrils of the secondary wall can be seen (Fig. 1b) as a result of peeling off of the surface of the filament. Figs 1c, 1d, 2d and 2e are photographs of jute filaments processed in a finisher card. Fig. 1c shows that there is surface peeling as a result of the action of cylinder pins and a portion of the pulled-out fibre is seen; Fig. 1d shows that there is a large transverse crack in a portion of the fibre. Surface abrasion of the filament is seen in Figs 2d and 2e, and in Fig. 2d the development of longitudinal cracks ultimately ends in a complete fracture in a portion of the filament. Such damages to the fibres were observed by Betrabet *et al.*<sup>8</sup> in cotton fibres in OE-spun yarns and by Munshi *et al.*<sup>9</sup> in cotton fibres in sewing thread. Fig. 1e shows that fibres are pulled out of the filament and in some places fibrils of secondary wall are visible as a result of processing in the first-drawing stage. In Fig. 2f, surface abrasion and cracks in the longitudinal direction are seen. Figs 1f and 2g are micrographs of jute filaments processed in the second drawing machine. In Fig. 1f there is surface abrasion, causing a part of the filament to come out of the surface, and a part of the filament

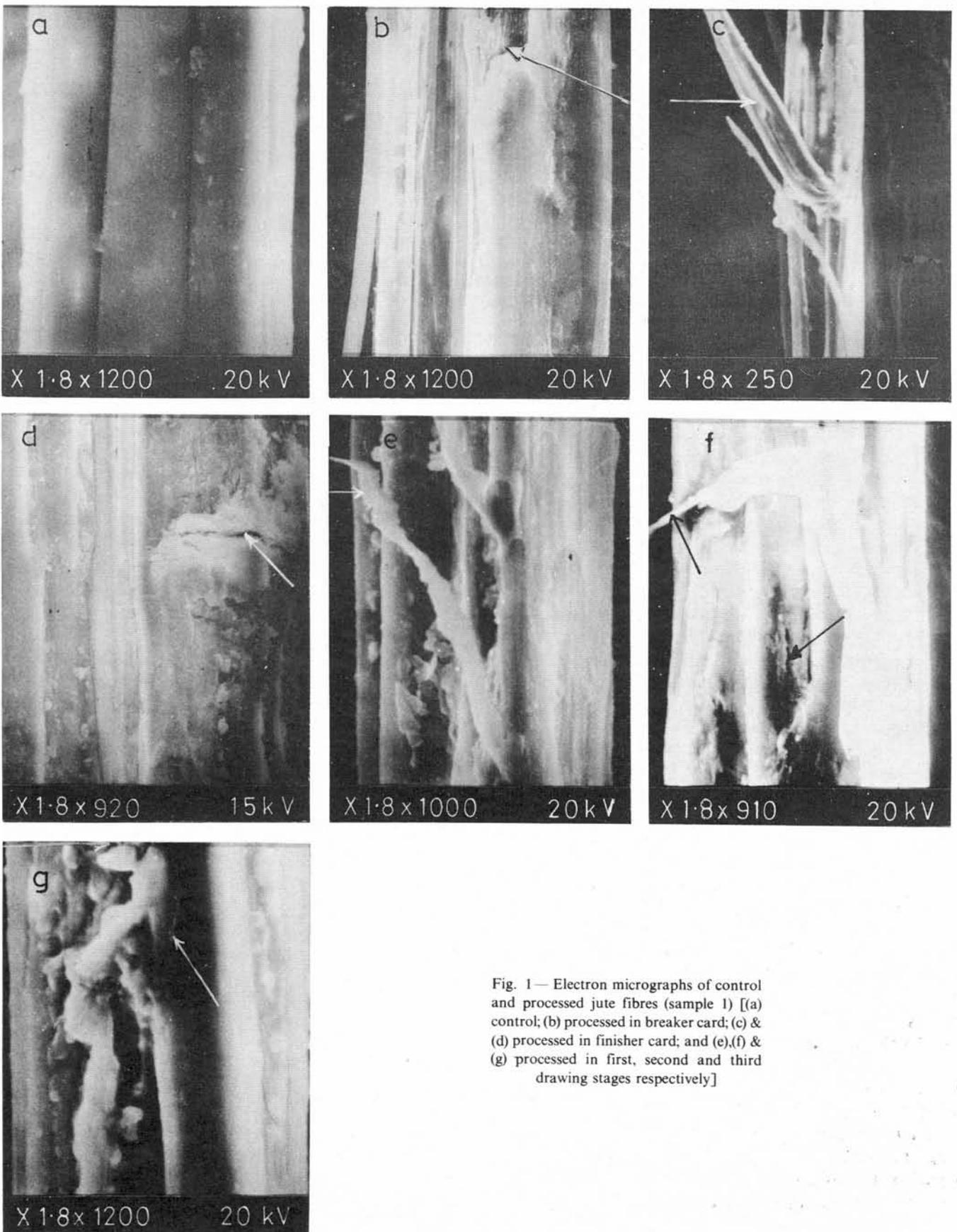


Fig. 1— Electron micrographs of control and processed jute fibres (sample 1) [(a) control; (b) processed in breaker card; (c) & (d) processed in finisher card; and (e), (f) & (g) processed in first, second and third drawing stages respectively]

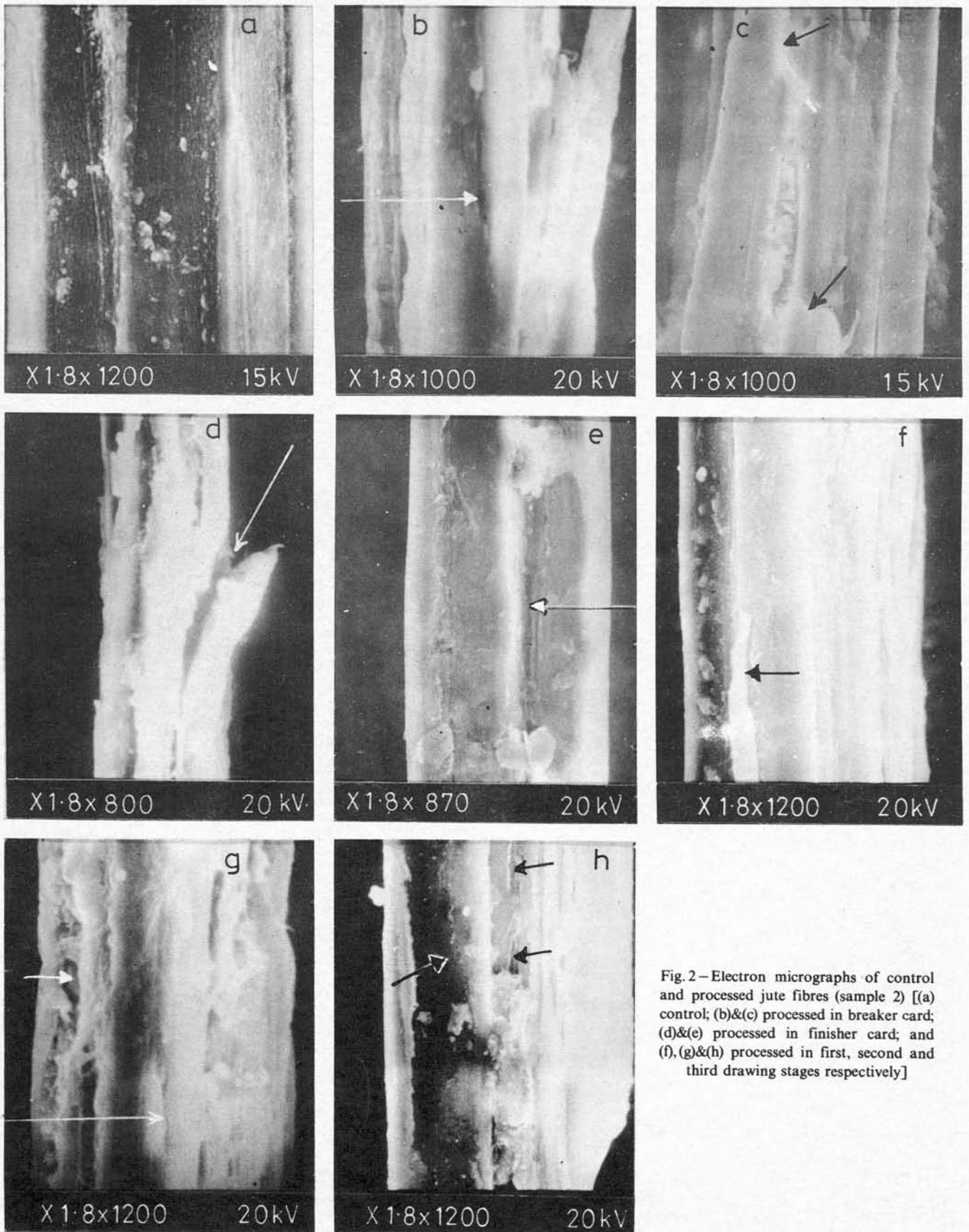


Fig. 2—Electron micrographs of control and processed jute fibres (sample 2) [(a) control; (b)&(c) processed in breaker card; (d)&(e) processed in finisher card; and (f), (g)&(h) processed in first, second and third drawing stages respectively]

shows complete fracture. Fig.2g shows that there is peeling off of the surface and development of a longitudinal crack on the fibre surface. Figs 1g and 2h show the filaments after being processed in the third-drawing stage. Both the micrographs show surface damage like abrasion, crack and fracture. However, if the filament from any subsequent stage of processing is examined, it would have already passed through the ~~previous stages~~ of processing. Hence, the damage caused to the filament may be due to the former stages, latter stages or to the sum total effect of ~~all~~ the stages of processing.

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