



Pig hair fibre utilization in India: Present status and future perspectives

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ABSTRACT

The hair or bristle, one of the key byproducts of pig slaughter, is used for making of brushes for domestic and industrial use. In the present review, the status of scientific knowledge on pig hair or bristle, SWOT analysis of hair sub-component of the piggery sector, balance of global trade and future prospects for promoting the effective pig hair fibre utilization by industries in India are described. The data on physical properties of pig hair or bristle remains sparse in spite of its widespread use in making different kinds of brushes in India and the world. Analysis of international trade data indicated that, India is primarily an importer of raw fibres and export accounts for less than 0.1% of the global trade. In India, most of the pig hairs/bristles are burned at the time of slaughter, wasting the valuable bio-resource permanently. On the other hand, the country imports raw fibre materials for catering the needs of domestic fibre industries. Thus, there exists abundant opportunities for promotion of pig hair fibre production and utilization in India. The advantages of promoting pig hair/bristle fibre for use in fibre industries include its superior tensile properties, availability, and environment friendliness. The industrial utilization requires detailed studies on physical and chemical characteristics of these fibres in relation with tensile properties. The efforts to promote pig fibre utilization will provide additional income to the pig farmers through better byproduct utilization, paving the way for employment generation for the rural youth through development of fibre based environment friendly industries.

Key words: Bristle, Hair fibre, Pig

As per latest estimates, there are 11.14 million pigs in India and about 40% of them are reared in the NER (DAHD 2012). The hair or bristle fibre, one of the key by-products of pig slaughter is used for making different types of brushes for domestic and industrial uses. The term fibre in the present review covers all the fibres obtained from the pig encompassing both hair and bristle. Most of the fibres from pigs are either burned or discarded at the time of slaughter, thereby wasting this valuable bio-resource permanently. In the present paper, we review the state of scientific knowledge in brief, strengths, weakness, opportunities and threats (SWOT) analysis of hair sub component of piggery sector, balance of global trade, and future prospects for promoting the effective pig hair fibre utilization by industries in India.

Status of knowledge on fibre characteristics

Bardoloi and Bujarbaruah (1984) studied characteristics

of pig hair/ bristle fibres in India and described the length, breadth, weight and optimal interval between each cutting in Khasi local, Hampshire, Large Black, and Saddle Back breeds of pigs. The study reported that the length of bristle varied between 5.23 and 9.61cm and the average yield of fibre per cutting differed between breeds (1.65 to 33.20g). Mohan *et al.* (2013) indicated breed-wise variation in the length of fibre (6.83 and 19.70 cm), with shortest and longest fibre length in Duroc and Niang Megha breeds respectively. The mean weight of individual fibre ranged from 2.06 to 5.06 mg. The colours of the fibre under natural conditions are shades of white, yellow, grey, brown and black depending upon the genotype of the animal.

The fibres in the neck region are thicker than those obtained from the back region of Indian breed of pigs (Niang Megha, Ghungroo and Ankamali). On the other hand, the length and thickness of the fibres from different body regions were uniform in the exotic breeds (Hampshire and Duroc). Thickness of the pig fibre varies between 185 and 380µm. Under a light microscope the pig fibre showed 3 distinct regions similar to those observed for other fibres of animal origin and human hair (Wildman 1958, Appleyard 1978). The regions identified in pig hair fibre are outermost thin cuticle (4.2 to 7.2µm), central medulla (22.3 to 42.6µm)

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and thick cortex (185.3 to 270.3µm) intervening between cuticle and medulla. The medullation is generally absent in the root region of the fibre, but starts appearing midway between tip and the root. The presence and pattern of medullation are considered as beneficial characteristic in certain types of fibres, but it is considered highly undesirable in fibres such as apparel wools and mohair (Lupton and Pfeiffer 1998). However, the pattern of genetic inheritance of various properties of the pig hair fibre including the relevance medullation is presently unknown.

The tensile properties such as breaking tenacity, extension at break, initial modulus and work of rupture were investigated for hair fibres obtained from different breeds of pigs. The tensile properties of hair fibre from Indian breeds of pig were found different from those obtained from exotic breeds (Hampshire and Duroc). Typically, tenacity of fibre ranges from 11.5 to 17.0cN/tex with extensibility between 31 and 38% (with a range between 22 and 40%). The work of rupture of fibre is about 0.045J/m/tex, indicating relatively high energy required for breaking fibre (Mohan, unpublished observations). The superior tensile properties of pig hair fibre suggest immense potential for the utilization of pig hair fibre for preparation of wide range of products. Further studies are required to understand physical and chemical characteristics of these fibres, especially in relation to its tensile properties, for further development of domestic and industrial products.

SWOT analysis of pig hair component

The strengths, weakness, opportunities and threats (SWOT) for the pig hair fibre production and its further application are summarized here.

Strengths: In India, millions of pigs reared with their ability to survive and produce under limited husbandry practices is a strength, particularly for the weaker, tribal and landless population of the country. Non perishable nature of the pig hair fibre is strength for fibre industry as fibre from slaughter site can be transported and utilized for product manufacture several weeks or months after collection. The fibre based product manufacturing units are not considered to be capital intensive and the farmer cooperatives, Non Governmental Organizations (NGOs), farmer groups etc. will be able to develop as a common facility. The technological requirement is medium for most of the regular applications of the fibres such as brush making, hence skill requirements of persons employed in such industrial units are also less intensive. The superior physical properties of the fibre such as high tensile strength and extensibility are strong points for the pig hair based industries. Our studies on flexural rigidity suggested that blending of pig hair fibres with other natural (plant and animal origin) and artificial fibres might be feasible. Production and commercialization of pig fibre based products presents avenues for employment and revenue generation among rural poor. Besides economic

considerations, use of natural fibres of porcine origin as carbon neutral resource will contribute towards reduction of carbon footprints and hence promote sustainable development (Van Dam 2008). The natural fibres derived from animals as well as plants are biodegradable, renewable, non-carcinogenic, non-toxic and therefore eco-friendly with application in many diversified sectors (Fisher 1981, Nayak and Roy 2011).

Weakness: Limited awareness among primary producers, absence of sufficient numbers of collection centres and marketing channels for pig hair fibres throughout the country is a weakness. The major share of hair obtained at the time of slaughtering is discarded as waste and never reaches market for further processing. Absence of proactive steps from the brush making industries to promote procurement of locally available pig fibres for the manufacture of products is a weakness in the value addition of these fibres. The availability of skilled labour for processing of pig hair into finished products is also one of major bottlenecks in the utilization of these fibres. Lack of adequate support from the developmental and financial bodies is also limiting the establishment and growth of pig byproduct based industries to the desired extent. In the absence of supportive industries in and around the areas where pigs are grown, by-product utilization suffers a setback for which economic returns are reduced.

Opportunities: Pig rearing is a supplementary activity, particularly for the tribal and weaker sections of the community, there are tremendous opportunities for poverty alleviation through the medium of piggery in the country. The sale of pig fibre could add to the profit of pig farming without much additional efforts in the existing farming activities. It is estimated that 84% of the total pig population is slaughtered (Ranjhan 2012). Considering that about 5 million adult pigs are slaughtered per year and each pig yielding 250g of fibre, the quantity of fibre availability will be to the tune of 1.25 million tonnes. In prevailing market rates of around Rs 800/kg of fibre, the total value of produce will be approximately Rs 100 crore. Since in the North Eastern region of the country alone, where around 50% of country's pork is consumed by way of procuring pigs from other parts of the country, immense opportunity exists for employment generation for rural youth in the piggery sector (NRC on Pig 2007). The increasing awareness among pig farmers' regarding value addition is an opportunity for the development of fibre based industries. Even though, the data on pig hair fibres are limited, the Bureau of Indian Standards (BIS) has recognized its potential value in the manufacture of brushes and has developed standards (IS 1844 of 1993) for pig bristles. The BIS specifications mention the use of "selected, properly straightened, natural black and soft/ semi-stiff bristles only" for brush manufacture. Since, already standards have been laid down for bristle and manufacture of different kinds of brushes by the BIS, these guidelines

can be considered as an opportunity for prospective entrepreneurs to manufacture different products. Enough prospects also exist to manufacture high end products such as biocomposites for medical and aerospace applications (medical and industrial textiles), which could fetch larger economic returns. Alternate opportunities will be to alter the properties of the fibres through processes such as bleaching, non-woven methods, blending with other natural and synthetic fibres etc. for manufacturing novel products. In nutshell, there is enough scope of value addition to the pig based fibres in India for development of existing or novel products.

Threats: The collection of pig hair is time consuming and cost intensive due to the un-organized nature of pig farming. The absence of viable channels among the farmers to gather the fibres after slaughtering increases the cost of collection and transportation of pig hair fibres to the processing centres. Hence, increasing cost of collection, elevating the cost of manufacture of the finished product, is a threat for utilization of these fibres. However, procurement through mechanisms such as farmer groups, cooperatives may facilitate smooth collection and transport of pig fibre to the manufacturing units. From public health point of view, the absence of by-product utilization facility particularly in areas of high slaughter rate, poses a threat (NRC on Pig 2007). The use of synthetic monofilament fibres for manufacture of brushes and other products are a threat to use of natural fibres in general and pig hair in particular.

Sources of pig hair fibre and balance of trade

Internationally commodity classification (as well as the code followed by Director General of Foreign Trade, Government of India) code 05 stands for all products of animal origin wherein 0502 stands for "Bristle, hair (pig, badger), brush making hair, waste". The code 050210 specifically describes "Bristles, hair and waste thereof of pigs, hogs or boars". The pig hair constitutes about 85% of the commodities transacted under the commodity head 050210 (UN Comtrade database 2012).

According to the UN Comtrade database (2012) India ranks ninth among the importers of pig hair or bristle worldwide. The share of Indian exports (2011) of pig hair can be considered as negligible. Indian share on import and export of world pig fibre was 4.01 and 0.094% (corresponding to 4.035 and 0.1125 million US dollars) respectively. Perusal of trends (Figs 1, 2) in import and export of pig fibre by India in terms of quantity and monetary value during the period 2007–11, revealed that pig hair/bristle fibres were imported mostly from China (94.1%) and remaining from United Kingdom, Switzerland and other countries. In the corresponding period, India exported pig fibre, including finished products to United Kingdom (34.0%), China and Australia (about 14.3% each), Japan (13.4%) and Belgium (6.1%).

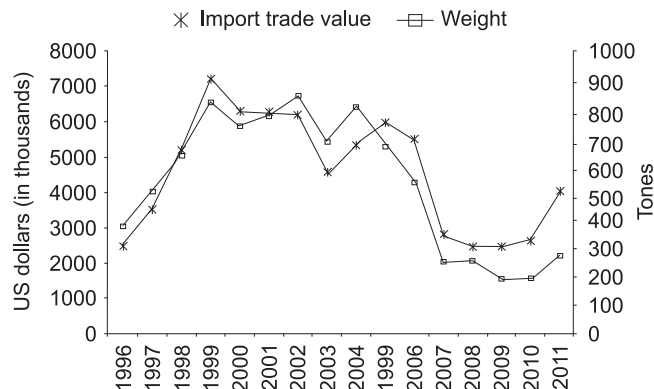


Fig. 1. Import of pig hair/bristle fibres by India in terms of quantity and monetary value during the period 1996-2011.

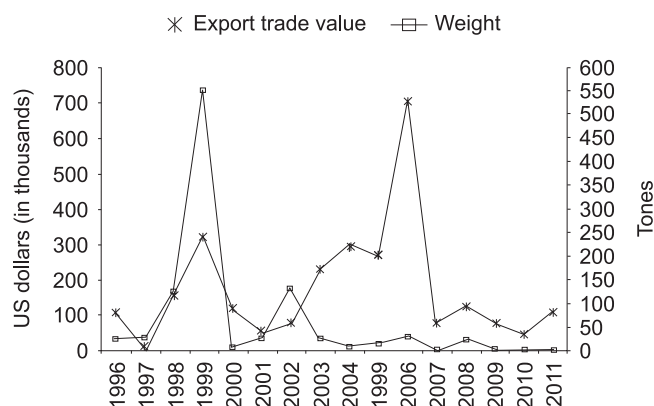


Fig. 2. Export of pig hair/bristle fibres by India in terms of quantity and monetary value during the period 1996-2011.

Worldwide import and export of pig fibre during the year 2011 was 130.518 and 145.82 million US dollars respectively. The worldwide import and export of pig hair fibres of the last three years of the reported period (2008–11) fluctuated from 100.62 to 124.86 and 119.39 to 139.40 million USD respectively. Germany (22.33 million USD), Italy (14.85 million USD), Brazil (9.48 million USD), Turkey (7.02 million USD) and Poland (6.16 million USD) were the major importers of pig fibre during 2011 (UN Comtrade Database 2012). Germany, accounting for 22.2% of the imports, topped the list of pig fibre importers. Worldwide, among the exporters of pig fibres, China dominated globally with a share of 86.1% (with a total value of 102.81 million USD). In terms of economic value, among the major pig fibre exporters, China was followed by Germany (13.85 million USD), USA (0.57 million USD), Italy (0.378 million USD) and the Netherlands (0.353 million USD) (UN Comtrade Database 2012).

Future perspectives

Considering the relevance and relative advantage of using pig hair fibres for increasing profit of pig farming community and development of useful products, efforts must be directed

to characterize fibres, support natural fibre industries, create awareness and improve market linkages of the primary producers with fibre industries. The Common Fund for Commodities of the Food and Agriculture Organization of the United Nations describes strategic areas for improving profile of natural fibres and promoting farmers welfare. The strategies advocated include increase in the awareness, demand stimulation and appropriate policy measures to tackle problems, fostering effective and enduring partnership, efficiency and sustainability among the fibre based industries (Common Fund for Commodities 2009). In India, an effective mechanism for collection of the fibres will be one of the key areas that requires attention for utilization of the fibre. Some of the steps for facilitating collection of pig hair fibres during slaughter will be through farmer groups, cooperatives, NGOs, self help groups etc. Another area that requires emphasis is the development of market channels or establishment of producer companies for processing of the pig hair fibres and their linking with existing fibre or brush making industries. The studies on detailed physical and chemical properties of these fibres are essential to identify novel utilities and realize maximal industrial potential. It can be concluded that abundant opportunities exist for promotion of domestic production of pig hair fibres and utilization in India. The efforts in this direction will provide additional income to the pig farmers through byproduct utilization, paving the way for employment generation for the rural youth through development of fibre based environment friendly industries.

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REFERENCES

- Appleyard H M. 1978. *Guide to the Identification of Animal Fibres*. 2nd edn, Pp. 2–27, 40–117. Wool Industries Research Association, Leeds, UK.
- Bardoloi R K and Bujarbaruah K M. 1984. Studies on Bristle Characteristics of Different Breeds of Pigs. *Annual Report*. Pp. 150–51. ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya.
- Common Fund for Commodities. 2009. *Proceedings of Common fund for commodities symposium on natural fibres*. Pp. 3–19. 20 October 2008. FAO, Rome, Italy.
- DAHD. 2012. *Annual report Department of Animal Husbandry and Dairying*. Government of India.
- Fisher C H. 1981. History of natural fibers. *Journal of Macromolecular Science: Part Chemistry* 15: 1345–75.
- Lupton C J and Pfeiffer F A. 1998. Measurement of medullation in wool and mohair using an optical fibre diameter analyser. *Journal of Animal Science* 76: 1261–66.
- Mohan N H, Das A, Debanth S, Nayak L K, Ray D P, Mustafa I and Satpathy K K. 2013. Physical characteristics of hair fibre obtained from different breeds of pigs. *Proceedings of Jute and allied fibres in changing times: issues and strategies*. 3–5 January, 2013. NIRJAFT, Kolkata, India.
- Nayak L K and Roy A K. 2011. Utilization of jute by-products: A review. *Agricultural Reviews* 32: 63–69.
- NRC on Pig 2007. *Vision 2025*. National Research Centre on Pig, Guwahati, Assam.
- Ranjhan S K. 2012. *Indian meat industry perspective*. FAO, Rome. Accessed at http://www.fao.org/docrep/ARTICLE/AGRIPPA/665_en-01.htm.
- U N Comtrade Database. 2012. *Bristle, hair (pig, badger), brush making hair, waste (HS 1996-2011 code 502)*. Accessed at <http://comtrade.un.org/db/ce/ceSnapshotd.aspx?px=H1&cc=050210&r=699>.
- Van Dam J E G 2008. Environmental benefits of natural fibre production and use. *Proceedings of Common Fund for Commodities Symposium on Natural Fibres*. Pp. 3–19. 20 October 2008. FAO, Rome, Italy.
- Wildman A B. 1958. *The Microscopy of Animal Textile Fibres*. Wool Industries Research Association, Leeds, U K.