

Inorganic dyes comprises of metal complex, e.g polypyridyl complexes of Ruthenium and Osmium, metal porphyrin, phthalocyanine and inorganic quantum dots, while organic dye comprises of natural and synthetic dyes. Consideration have been made on natural pigments as a promising alternative sensitizer dyes for DSSC because of their simple production technique, affordable cost, complete biodegradation, easy availability, purity grade, environmental friendly, high reduction of noble metal, and chemical synthesis cost [31–33]. The performance of natural dye sensitizer in DSSC has been estimated using fill factor (FF), energy conversion efficiency ( $\eta$ ) ( $J_{sc}$ ), open circuit voltage ( $V_{oc}$ ), and short circuit current. Plant pigmentation results from the electronic structure of pigments reacting with sunlight to change the wavelengths as may be perceived by the viewer. Reviews of Dyes Used in DSSCs The dyes applied in DSSCs are categorized into two types which are organic and inorganic dyes. Many parts of a plant have been tested by Researchers (see Table 1) and various useful dyes have been highlighted as photo-sensitizers for DSSC from natural products [35–42]. Common pigments are (a) Betalains (b) Carotenoids (c) Chlorophyll and (d) Flavonoids as Anthocyanins etc. Naturally, the fruits, flowers and leaves of plant shows different colors from red to purple and include different natural dyes which can be extracted using simple procedure and used for DSSC fabrication [30]. Natural dyes offers a suitable alternative to high cost inorganic based DSSCs. The pigment can be described by the maximum absorption wavelength ( $\lambda_{max}$ ) [34]. Structures of some natural dyes employed in DSSCs are shown in Figure 2, 3 and 4. Flavonoids are widely distributed plant pigments. Natural Dye Sensitizers Another type of dye sensitizers used is the organic or natural dye. Flavonoids