The use of proton exchange membrane (PEM) is very significant component in PEMFC and DMFC. It functions to separate anode and cathode, prevents fuel gas crossover, and transports protons from anode to the cathode through it. Nafton is widely used as a PEM material in commercial PEMFC due to high proton conductivity, good mechanical, chemical stability and excellent thermal stability. However, seeking for new materials as an alternative to Nafton is needed due to its expensive, low proton conductivity when temperature operation above 100 °C and high fuel permeability. As an alternative, sulfonated poly(ether ether ketone) (SPEEK) based membrane is a potential candidate due to low cost, exhibit good chemical and thermal stabilities. However, SPEEK with high degree of sulfonation (DS) exhibits gradually deterioration of the mechanical properties, excessive water uptakes at elevated temperatures and methanol permeability that leads to the reduction in cell voltage performance. The use of hybrid membrane is one opportunity to overcome the SPEEK drawbacks. Hybrid and Chitosan can be crosslinked through sulfonic (-SO3H) and amine (-NH2) functional groups. Introduction of Chitosan into SPEEK membrane can modify SPEEK properties particularly by improving its swelling ability. Several series of cross-linked membranes of SPEEK with a chitosan were prepared by solution cast technique. SPEEK and Chitosan was dissolved in DMSO and acetic acid, respectively. They were then mixed together and stirred until homogenous solution obtained. The solution was then exposed and treated under ultra violet (UV) light for curing process. Only six samples were prepared with different composition. The composition are pure SPEEK, 90 % SPEEK with 10 % Chitosan, 80 % SPEEK with 20 % Chitosan, 70 % SPEEK with 30 % Chitosan, 60 % SPEEK with 40 % Chitosan and 50 % SPEEK with 50 % Chitosan. The membranes were then characterized by evaluating physical properties, physicochemical properties, thermal properties and electrical properties. Physical properties were analyzed through the results of DS, Fourier transform infrared (FTIR), X-Ray diffractogram (XRD) and surface morphology. The best composition of SPEEK with 74.2 % DS was successfully prepared. The FTIR study revealed considerable interaction between the sulfonic acid functions of SPEEK and amino groups of chitosan. No defects were observed on cross-section surface morphology. Physicochemical properties were analyzed through the results of water uptake, degree of swelling and ion exchange capacity (IEC). The results showed that water uptake decreases with increasing of chitosan content from 52 % to 29 %. While, IEC decreases from 0.188 to 0.018 mequi. Thermal properties were studied using the results of TGA and DSC. Results showed that there is not much effect can be seen on both TGA and DSC trend. Characterizations of proton conductivity and transference number were conducted to further study electrical properties of the membranes. It is found that activation energy increases from 10.6 to 90.9 kJ/mol, while proton conductivity of the membranes decreases from 8.51 x 10^{-3} to 2.85 x 10^{-7} Scm^{-1}. Ionic transference numbers are found to be in the range of 0.81 to 0.94, indicating the conductor species in the electrolyte membrane system is predominantly ionic. The results from characterizations showed that the optimum sample which is 10 % Chitosan with 90 % SPEEK might be as a good potential candidate to modify the SPEEK properties.

In the present work, phytochemical and pharmacological studies were conducted on four species of plants from three different families. The studied plant samples were the air-dried lianas of two species from Gnetaceae family which are Gnetum microcarpum Blume and Gnetum cuspidatum Blume and the twigs of Cynometra cauliflora Linn from the family of Fabaceae and Bouea oppositifolia (Roxb.) Meisn from the family of Anacardiaceae. The aims of this study are to isolate the secondary metabolites from the plants, to propose biogenetic pathway of the new isolated compounds, to determine their DPPH scavenging, PGE2 inhibitory and cytotoxic activities and to study the Structure-Activity Relationship (SAR). The isolation process was done by conventional method of maceration, fractionation, separation and purification using several chromatographic techniques and structural elucidation was based on the spectroscopic data evidences and comparison with reported authentic data. Phytochemicals investigation on the lianas of the two Gnetum species yielded 11 known stilbenoid compounds: resveratrol (1), isorhapontigenin (3), naringenin (10), gnetifolin (18), gnetofuran (20), gnetucleistol (21), cuspidan (B) (24), e-viniferin (31), parvifolol (D) (44), gnetol (40), and gnetonol (48) and malaysianol (388), two new compounds from G. microcarpum characterized as malaysianol E (25), malaysianol F (389) and gnetonol M (48) and malaysianol D (388), two new compounds from G. cuspidatum, namely malaysianol G (399). Phytochemicals investigation on C. cauliflora and B. oppositifolia gave 16 known flavonoid compounds: naringenin (263) and eriodictyol (262) were obtained from both species; flavone apigenin, acetatin, luteolin, luteolin 3',5 dimethyl ether, 3',4',7-trihydroxyflavone, 4',7-dihydroxyflavone (392-397) and 5,7-dihydroxychroomone (391) from C. cauliflora; chalcone isoquiritigenin (398), flavanone liquiritigenin and butin (399-400), flavanol taxifolin (260), fustin, garbanzol (401-402) and aurone sulforin (403) from B. oppositifolia. Both flavonoids and stilbenoids were derived from the combination of shikimate pathway and acetate pathway from a cinnamoyl-CoA starter unit and three molecule of malonyl-CoA extender unit to form intermediate polyketide. The enzyme stilbene synthase (STS) gave resveratrol which then undergo polymerization to produce larger stilbenoid, while chalcone synthase (CS) gave chalcone which then act as precursor for a vast range of flavonoid derivatives. In the DPPH assay, gnamol M (48) and fustin (260) displayed good scavenging activity with IC50 of 30.07 and 23.93 μM, respectively, higher than that of standard trolox (IC50 83.22 μM). In the PGE2 inhibition assay, gnamol M (48) and 4',7-dihydroxyflavone (397) exhibited significant activity with IC50 of 1.15 and 3.39 μM, respectively, comparable to the standard, indomethacin (IC50 1.29 μM). For cytotoxicity, all the tested compounds were found to be, either moderate, weak or not cytotoxic against HCT116 cancer cell line. In the SAR study of DPPH scavenging, the number of hydroxyl groups and the presence of an electron donating group are essential for stilbenoids. While the catechol moiety is in the top priority to exert flavonoids activity. Meanwhile, both type of compounds required the substituents which will contribute to their hydrophobicity and balance number of hydroxyl group in their structure in order to exert better PGE2 inhibitory activity.