Abstract This paper presents a new variant of ant colony optimization (ACO), called EnRiched Ant Colony Optimization (RACO). This variation tries to consider the previously traversed edges in the earlier executions to adjust the pheromone values appropriately and prevent premature convergence. Feature selection (FS) is the task of selecting relevant features or disregarding irrelevant features from data. In order to show the efficacy of the proposed algorithm, RACO is then applied to the feature selection problem. In the RACO-based feature selection (RACOFS) algorithm, it might be assumed that the proposed algorithm considers later features with a higher priority. Hence in another variation, the algorithm is integrated with a capability local search procedure to demonstrate that this is not the case. The modified RACO algorithm is able to find globally optimal solutions but suffers from entrapment in local optima. Hence, in the third variation, the algorithm is integrated with a local search procedure to tackle this problem by searching the vicinity of the globally optimal solution. To demonstrate the effectiveness of the proposed algorithms, experiments were conducted using two measures, kappa statistics and classification accuracy, on several standard datasets. The comparisons were made with a wide variety of other swarm-based algorithms and other feature selection methods. The results indicate that the proposed algorithms have superiorities over competitors.