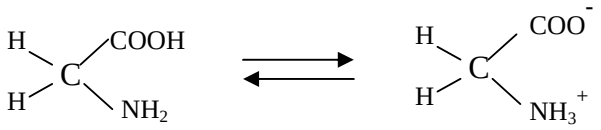
It is one of the well known facts that the amino acids (The Alpha-Amino Acids) exist in zwitterionic form in aqueous media. There is equilibrium between the non-zwitterionic and the zwitterionic forms of these acids to varying degrees in the variety of pH values in which they can occur.



The organic chemistry text books assert that for the alpha amino acid the acidic part is the $-NH_3^+$ group (not the –COOH) and the basic part is the $–COO^-$ (not the $–NH_2$) group.
That means that the Zwitterionic form is the predominant isomer of the two. These conclusions are based on setting up certain reactions and analyzing for the products formed, estimation and comparisons of pK_a and pK_b values etc. Some books on natural product chemistry state that the Alpha amino acids exist Zwitterionic form in the solid state.

If all these were in aqueous media what is the situation for the isolated molecule of alpha-amino acids? What kind of experiment can be available for characterizing the structure of isolated molecule for this class of compounds? Obviously the recent reports on such matter invariably includes Quantum Chemical calculations with the experimental results; the experimental technique used have been Infra Red Spectroscopy (the vibration spectra)

In fact the molecular spectra yield the molecules electronic structure as result and to know specifically the proton migrations and binding in molecules can the Proton Magnetic resonance be useful? The NMR technique has advanced to such an extent and its applications to biological macromolecules are becoming emergent tools. Even then the study of the situation of isolated molecule of an amino acid seems not so easy to access by NMR.

The theory has been applied for calculating stability of structures of alpha amino acid molecules but the conclusion have been not so much to be confident about the structures but rather only seems to be optimistic trends for improving the theoretical method.

There are several softwares currently available for routine use of advanced theoretical methods with variety of basis sets and approximations. Abinitio SCF - HF method with Slater Type Orbitals STO as basis sets, or Gaussian basis sets, much fatser semi-empirical methods based on the ZDO approximation, and the more recent Density Fuctional Theoretical DFT frame work; are all available as soft ware packages. For molecular modeling studies , molecular mechanics MM is being developed as an alternative to QM methods, and the molecular electrostatic potential MEP can be used instead of charge densities to infer better the distant (long range) interactions All these are possible but what is the result till now on isolated molecule stabilities and structure of alpha amino acids? The extensive theoretical studies by Bernard Pullman indicate more short comings of the computational methods and somewhat compromising trend in the conclusions about structure and stability.With these background as given in the last few display sheets, an effort is being made to use the main STO 3G bais SCF/RHF abinitio calculations to get a lead into the trends. A limited extent results of DFT calculations are included in this contribution. The next sheet summarizes what really the state of information is as far as alpha amino acids are concerned.

http://www.ugc-inno-nehu.com/crsi_13nsc_nmrs2007.html

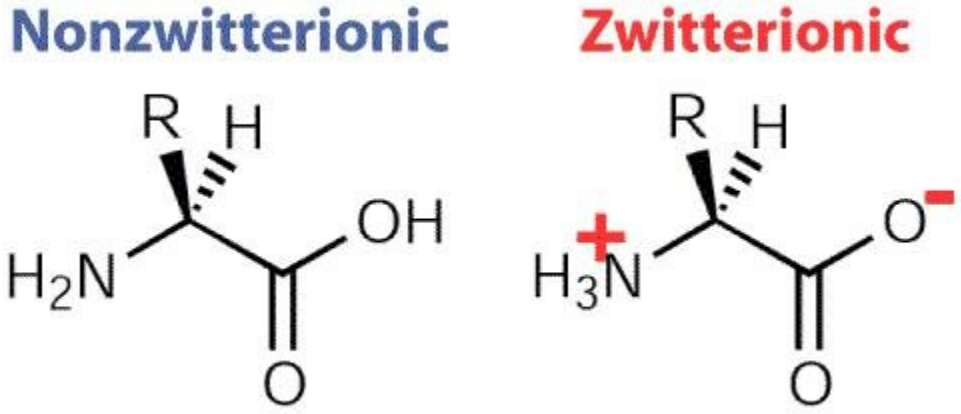
Williams Group

Less active projects

http://www.cchem.berkeley.edu/erwgrp/science_old.html

Zwitterion Stability in the Gas Phase

All naturally occurring amino acids are nonzwitterionic when isolated in the gas phase, despite existing as zwitterions in aqueous solutions over a wide pH range. There are many ways to stabilize the zwitterionic form of amino acids in the gas phase, including increasing the proton affinity of the proton accepting group and by forming interactions with molecules and ions. We have previously studied some aspects of these effects with black body infrared radiative dissociation (BIRD).



http://www.cchem.berkeley.edu/erwgrp/mattbush.html

The *in vivo* structure of biomolecules is the result of both *intra*molecular interactions intrinsic to the molecule and *inter*molecular interactions with surrounding solvent and neighboring molecules. These effects are each significant and often favor radically different structures. For example, amino acids in aqueous solution are zwitterions over a wide pH range, even though nonzwitterionic structures are energetically favored in the gas phase. Clearly water preferentially stabilizes the zwitterionic form of amino acids. While this general concept is well understood, the full structural impact of water on biomolecular structure remains poorly characterized. These studies yield detailed information on zwitterion stability and contribute towards a general understanding of zwitterion and salt-bridge formation in biological systems

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Question is: Is it possible to specifically infer these various types of interactions and the corresponding break-up in enrergy?

http://www.ugc-inno-nehu.com/crsi_13nsc_nmrs2007.html