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The Real Benefits of Microwave-assisted Processing Go Beyond Time Savings

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Microwave-assisted processing, from its inception, has been a methodology that promised time savings over conventional processing methods [1]. It has taken a number of years since the mid 1990's to define and develop control of the variables associated with microwave processing. There are 3 important components to consistent results that have been elucidated through research and controlled with technological advancements [2-5]. Stated simply they are: 1) the development of a device to provide energy uniformity in the microwave cavity [2-3], 2) the creation of a true wattage microwave device (continuous power over a range or wattages) [2-5], 3) independent sample temperature control in conjunction with continuous microwave radiation [3-4].

While the precise method of activation that microwave radiation contributes to accelerating a wide range of processing applications is unknown the control of microwave-assisted sample heating and magnetron wattage are now routine. The role of sample temperature in the following applications is better understood: tissue processing for electron microscopy [2], immunolabeling [3], formaldehyde fixation [4] and decalcification [5]. The importance of true wattage and a uniform microwave environment to all four applications has been demonstrated experimentally [2-5].

Recent work has shown, concurrent with time savings, improved results over conventional methods when microwave-assisted fixation is incorporated into a protocol [4]. The results clearly demonstrate that a 20 minute microwave-assisted formaldehyde fixation relying on temperature control, true wattage and a uniform microwave environment produce ultrastructural detail not attainable with a 3-hour immersion fix (Fig. 1).

Recently submitted research defines the fixation benefit further. *HeLa* cells were transfected with Cellular Lights Tubulin-GFP (Invitrogen, Carlesbad, CA) and 3 days later formaldehyde fixed for 1 minute at 150W true wattage, labeled with mouse anti-GFP followed by Alexa 488–goat anti-mouse IgG (Invitrogen, Carlesbad, CA). The results were contrasted with identical cells conventionally fixed for 30 minutes (Fig. 2).

The two figures clearly demonstrate that accelerated fixation times (over 30-fold quicker than conventional methods) under a controlled microwave processing environment result in significant time savings concurrent with excellent processing results.

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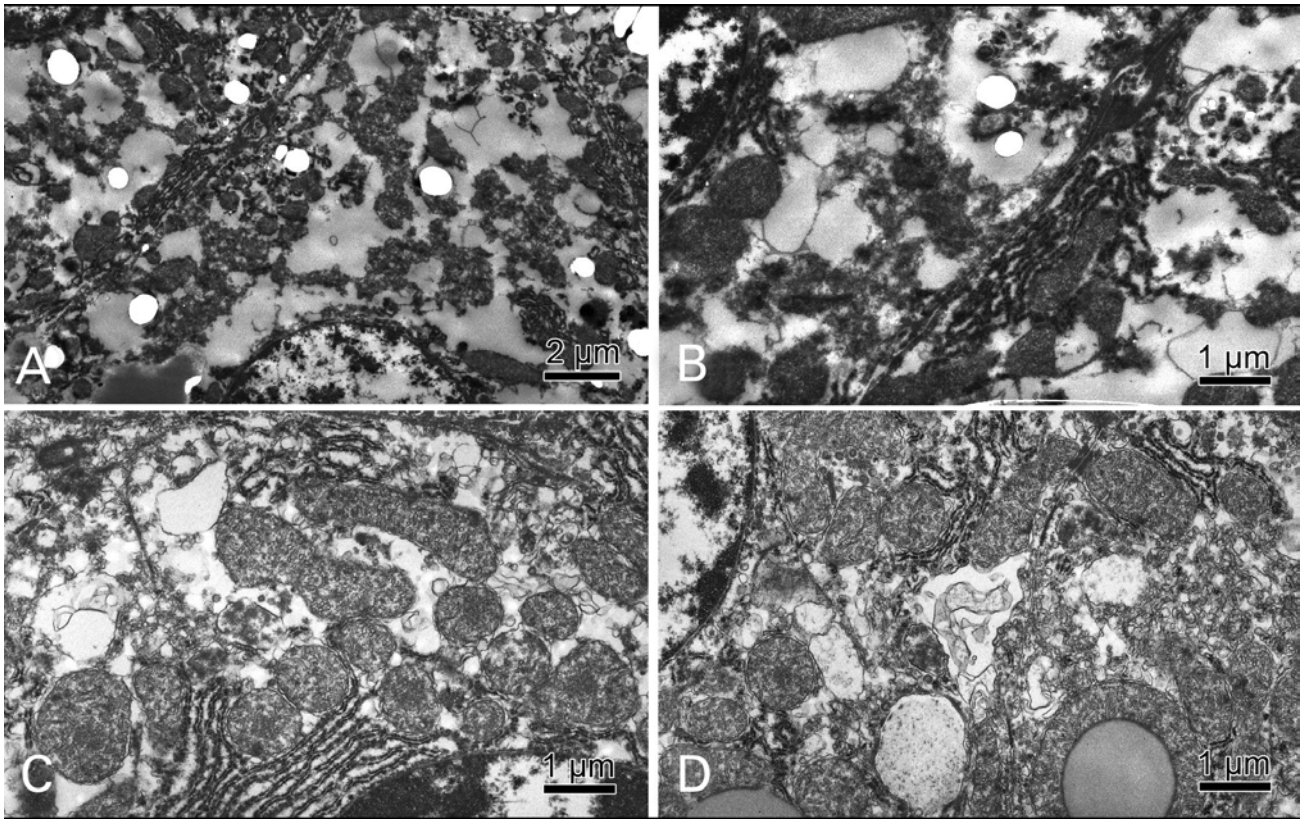

Fig. 1. Electron micrographs of ovine liver fixed in 10% neutral buffered formalin (10% NBF) by conventional and microwave methods. A-B. Tissues fixed conventionally for 3 hours. Note the extraction and absence of organelles. C-D. Tissues fixed with microwave radiation [4]. Note the greatly improved ultrastructure.

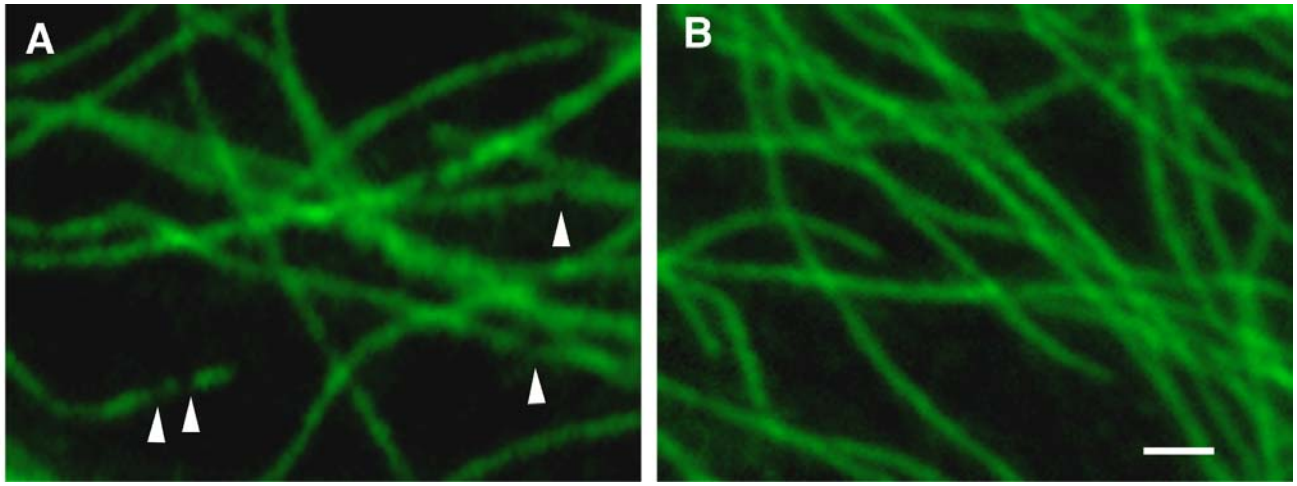

Fig. 2. *HeLa* cells transfected with CellularLights, tubulin GFP (Invitrogen, Carlesbad, CA) fixed in 3% formaldehyde and the labeled with an anti-GFP antibody followed by Alexa 488. A. Cells fixed conventionally for 30 min. at 37C. The continuity of label down the microtubules is not uniform (arrows). B. Transfected *Hela* cells fixed in the presence of 150W of microwave radiation for 1 min. at 37C. The continuity of the label is superior to A above. Bar = 2 microns.

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